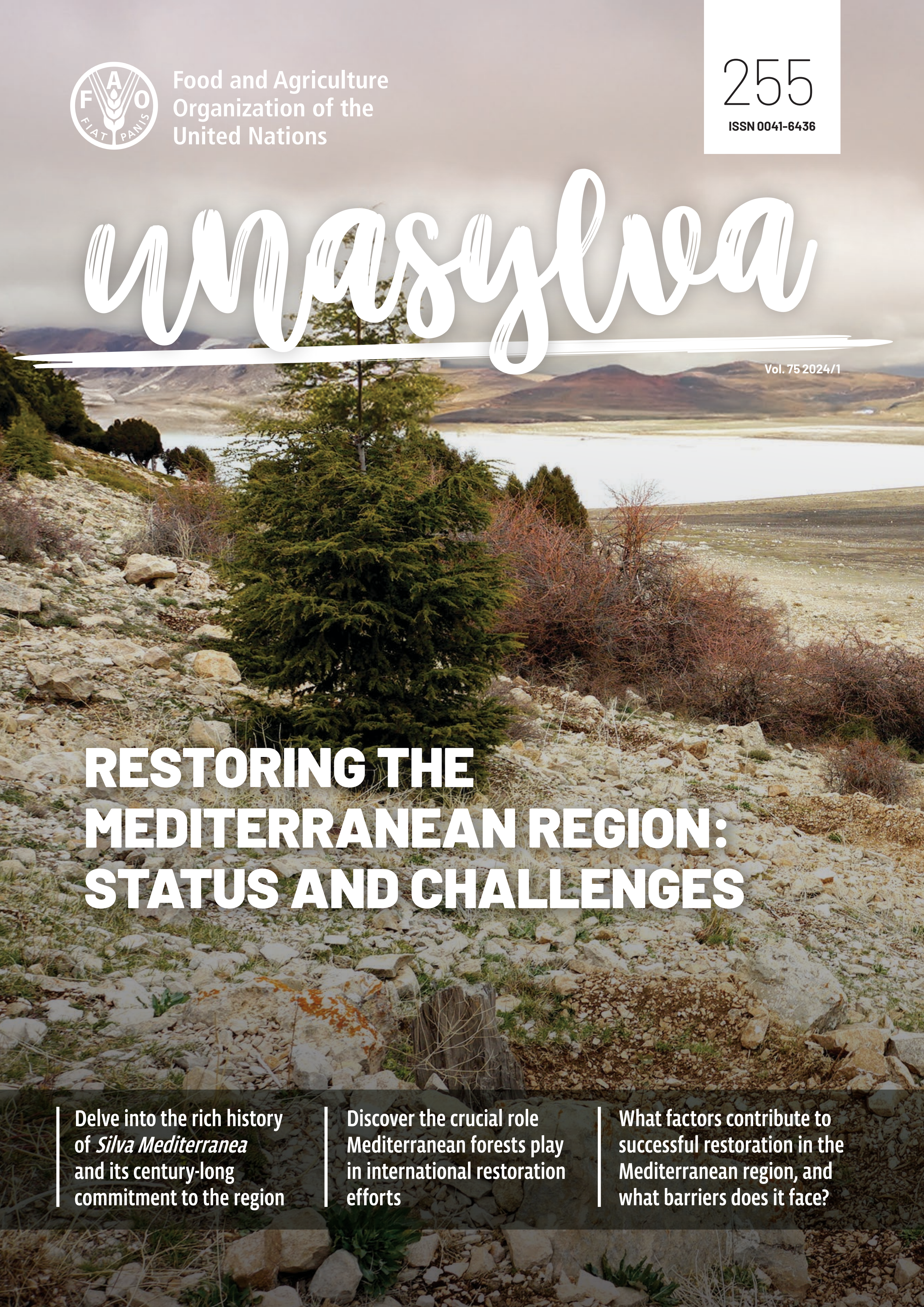

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RESTORING THE MEDITERRANEAN REGION: STATUS AND CHALLENGES

Delve into the rich history of *Silva Mediterranea* and its century-long commitment to the region

Discover the crucial role Mediterranean forests play in international restoration efforts

What factors contribute to successful restoration in the Mediterranean region, and what barriers does it face?

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Editorial 3
Zhimin Wu, Director, FAO Forestry Division

Foreword 5
Ümit Turhan, *Silva Mediterranea Chair, Türkiye*

SECTION 1 • PAST AND CURRENT REGIONAL DYNAMICS 7

Italian support to the FAO Committee on Mediterranean Forestry Questions – *Silva Mediterranea*: background and current initiatives 7
Enrico Pompei, Paola Fiore, Giovanbattista de Dato, Giovanni Di Matteo,
Lucia Rivera Lima, Silvia Ferlazzo, Marina Vecchio, Fulvio Ducci

A decade of French support to Mediterranean forests 15
Nicolas Picard,[1] Nelly Bourlion,[2] Iris Le Roncé,[3] Christophe Besacier[2]

Restoration in the Mediterranean, a journey towards renewal: the converging and interlinked agendas of the Union for the Mediterranean 21
Alessandra Sensi, Laurent Alfonso, Anna Dorangricchia, Giuseppe P
rovenzano, Doha Zamel, Yasmine Kefti

Catalysing restoration efforts in the Mediterranean region through the United Nations Decade on Ecosystem Restoration 2021–2030 30
Andrea Romero Montoya, Christophe Besacier, Serena Corezzola, Ümit Turhan,
Giovanbattista de Dato, Carolina Gallo Granizo, Valentina Garavaglia,
Alessio Martinoli, Marcello Miozzo, Chadi Mohanna, Cristiane Sater Melnik

SECTION 2 • KEY TOPICS FOR RESTORATION IN THE MEDITERRANEAN REGION 39

The status of restoration in the Mediterranean region 39
Giovanbattista de Dato, Lucia Rivera Lima, Dania Abdul Malak,
Virginia García Millán,[2] Valentina Garavaglia

The Mediterranean Forest Research Agenda and land degradation in the Mediterranean region 46
Magda Bou Dagher Kharrat, Mercedes Caron, Carola Chiusi,
Eduard Mauri, Michele Bozzano

Upscaling forest and landscape restoration in the Mediterranean region: key achievements in Lebanon and Morocco 50
Elias Chnais, Valentina Garavaglia, Chadi Mohanna, Khalid Cherki,
Ahlame Sghir, Christophe Besacier

Mediterranean fire weather and restoration perspectives in a changing climate 58
Carolina Gallo, Valentina Bacciu, Sahbi Bedhiaf, Bastien Dieppois, Peter Fulé, Ali
Kavgacı, Lara Steil, Jonathan Eden

The Mediterranean Model Forest Network: involving rural communities in designing restoration projects 69

Andrea Barzagli, Hafeda Benmammar, Stefano Berti, Francesco Drosera, Elisabetta Gravano, Mohamed Moumani, Émilie Sasseville, Toni Ventre, Richard Verbisky, Patrick Wylie

SECTION 3 • THE FUTURE OF RESTORATION IN THE MEDITERRANEAN REGION **68**

Status and priorities of the younger generations in the Mediterranean forest sector 77
Lucia Rivera Lima, Leila Rossa Mouawad, Hiba Mohammad, Rhea Kahale, Florence Lacrosse

Regenerating the arid Mediterranean: women's resourcefulness leads the fight against climate change 91
Lucia Gerbaldo, Maureen Vargas, Victoria Valenzi

Monitoring restoration in the Mediterranean region 99
Francisco Gallego Ciprés, Elias Chnais, Silvia DÍaz-Fernández, Carolina Gallo, Luis Carlos Jovellar, Tomás Sánchez

The power of communication to enhance restoration in the Mediterranean region 109
Patricia R. Sfeir, Leila Rossa Mouawad, Bernadette Karam, Caterina Marchetta

Editorial

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Zhimin Wu, Director,
FAO Forestry Division

In 2015, Mediterranean forests covered 10 percent of the total land area of Mediterranean countries.[1] An estimated 88 million hectares of forests – 25 million hectares of which are of Mediterranean forest type and about 50 million hectares of which consist of other Mediterranean wooded land – make crucial contributions to the provision of forest foods, renewable biomaterials and energy, and are essential for biodiversity conservation, carbon and water cycle processes, soil conservation and fertility, and disaster risk reduction. However, Mediterranean forests provide many other benefits: sustainably managed forest ecosystems can reduce the impacts of drought, desertification, soil erosion, landslides and floods. They are also associated with beneficial effects on human health through opportunities for recreation and ecotourism.

The Mediterranean basin has a long history of human activity, which, coupled with its climatic regime, has resulted in plant adaptations to clearing, grazing, fires and drought. But land-use intensification, urban development and climate change have led to degraded lands with reduced provision of ecosystem services, low biological productivity and slow recovery rates after disturbances or abandonment. Climatic and demographic projections show that the future of Mediterranean forests could be undermined. Several factors driven by climate change and demographic growth will further affect the functioning of ecosystems and the provision of goods and services. The alteration of forest ecosystems is also a major contributor to disease emergence.[2]

Restoration is the main means to reverse land degradation and to recover the composition, functioning and sustainability of ecosystems, thus contributing to improving livelihoods and the well-being of local communities.

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[1] FAO & Plan Bleu. 2018. *State of Mediterranean Forests 2018*. Rome, FAO & Marseille, France, Plan Bleu.

[2] FAO. 2022. *How natural resource management sectors can contribute to reducing emerging infectious diseases: the example of forest ecosystems – Policy brief*. Rome. https://doi.org/10.4060/cc2752en

In the first half of the twentieth century, many restoration projects relied on a silvicultural approach based on tree stands with little diversity (monospecific afforestation). This type of restoration practice has been progressively replaced by an approach more focused on the landscape, ecosystems and natural processes, and incorporating diverse land uses and plant species (forest and landscape restoration).

The very first *Unasylva* edition on Mediterranean forests was published in 1999, celebrating 50 years of cooperation in Mediterranean forestry. It was followed more recently by an issue on the Mediterranean region (issue 242) in 2014. Released a decade later, this edition of *Unasylva* aims to present the status of Mediterranean forest resources, focusing specifically on restoration efforts, recent developments and opportunities to achieve regional and global pledges. It explores the status of restoration in the region, its progress and challenges, and the tools and approaches available to help increase both the quality and quantity of restoration on degraded land. This edition provides a unique opportunity for the Mediterranean community of experts and stakeholders to show their collaborative work and the energy and initiative of a region whose work is based on strong cooperation among countries and partners.

Restoring degraded Mediterranean forest ecosystems can contribute to increasing global forest cover in what is one of the 36 global biodiversity hotspots. While occupying 1.6 percent of the Earth's land surface, the Mediterranean basin hosts approximately 7 percent of the world's plant taxa, with almost 25 000 native species,[3] more than half of which are endemic to the region. The Mediterranean basin is therefore a key area for the long-term conservation of genetic and taxonomic diversity.

Restoring Mediterranean forests contributes to the 2030 Agenda for Sustainable Development, especially Sustainable Development Goal 15, "Life on Land",[4] and the target to increase forest area globally by 3 percent by 2030 set by Global Forest Goal 1[5] of the United Nations Strategic Plan for Forests 2017–2030.[6]

Supporting and scaling up efforts to prevent, halt and reverse the degradation of Mediterranean forest ecosystems also contribute to the main objective of the United Nations Decade on Ecosystem Restoration (the "Decade") proclaimed by the United Nations General Assembly for 2021–2030, by promoting restoration action in the Mediterranean basin.

This special issue on the Mediterranean region contributes to assessing the restoration efforts that the Decade seeks to promote on a global scale. It includes 13 articles with concrete case studies evenly distributed across the region.

The articles are organized into three main sections:

- **Past and current regional dynamics**. This collection of articles presents perspectives from Mediterranean countries on the role of restoration in the region. A decade of French financial and technical contribution to the secretariat of the Committee on Mediterranean Forestry Questions – *Silva Mediterranea* and the current view from the Italian-led secretariat are showcased. The political perspective of the Union for the Mediterranean is also detailed, together with the role of the Mediterranean region in the ongoing Decade.
- **Key topics for restoration in the Mediterranean region**. This section shines a light on key topics related to restoration in the basin, from a brief review of ongoing restoration activities to exploring the role of research. Examples from ongoing projects and partnership-based restoration approaches are also described. Fires and post-fire restoration are examined in depth, given the importance of fire management in the sustainable management of forest ecosystems in the Mediterranean region.
- **The future of restoration in the Mediterranean region**. These articles focus on topics that are gaining attention in the Mediterranean and that will require driving-power on a regional level to come to the fore. The role of youth and women in the Mediterranean forest sector and specifically in restoration efforts is analysed. The need to monitor restoration activities to better assess achievements is also crucial to mobilizing resources. The importance of communicating effectively about restoration is also discussed, with an overview of the status of communication efforts in the Mediterranean.

This edition of Unasylva *was coordinated by FAO's Forest and Landscape Restoration Mechanism team under the overall supervision of Christope Besacier and led by Valentina Garavaglia, with the support of Francesca Rose Ferraro. It was conceived and produced with the key contribution of Mediterranean partners, stakeholders and members of the Committee on Mediterranean Forestry Questions – Silva Mediterranea and with financial support from the Korean Forest Service, the Ministry for Ecological Transition and Demographic Challenge of Spain and the International Climate Initiative implemented by the Federal*

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[3] FAO & Plan Bleu. 2018. State of Mediterranean Forests 2018. Rome, FAO & Marseille, France, Plan Bleu.

[4] Sustainable Development Goal 15, "Life on Land": Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (https://www.globalgoals.org/goals/15-life-on-land/).

[5] Global Forest Goal 1: Reverse the loss of forest cover worldwide through sustainable forest management, including protection, restoration, afforestation and reforestation, and increase efforts to prevent forest degradation and contribute to the global effort of addressing climate change (https://www.un.org/esa/forests/wp-content/uploads/2017/09/UNSPF-Briefing_Note.pdf).

[6] E/RES/2017/4 (*United Nations strategic plan for forests 2017–2030 and quadrennial programme of work of the United Nations Forum on Forests for the period 2017–2020*). Economic and Social Council, 2017. Also available at: https://documents-dds-ny.un.org/doc/UNDOC/GEN/N17/184/62/PDF/N1718462.pdf?OpenElement

Foreword

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Ministry for Economic Affairs and Climate Action of Germany.

Ümit Turhan, *Silva Mediterranea* Chair, Türkiye

In 2014, following up on the issue published in 1999, *Unasylva* 242, entitled "A new dynamic for Mediterranean forests", brought to light the efforts and initiatives deployed in the Mediterranean region to acknowledge, protect and promote the many services provided by Mediterranean forest ecosystems. These are threatened by climate change and multiple human pressures and exposed to rapid social and environmental change.

The issue highlighted the substantial technical resources of Mediterranean countries and the strong political will across the region to find solutions and tackle issues collaboratively. It emphasized the need for a holistic approach to Mediterranean forestry issues for sustainable and integrated solutions to be achieved. Since then, several initiatives have emerged through collaborative work among Mediterranean partners and institutions concerned with the future of Mediterranean forests. These initiatives have involved regional cooperation actions to improve forest management and enhance its benefits for society, ensuring that both research and policy align within a regional approach, and translating political will into action.

Since its creation, the Committee on Mediterranean Forestry Questions – *Silva Mediterranea* has supported Mediterranean countries and the Mediterranean community of experts and stakeholders in the sustainable management of forest resources. It has played a pivotal role in promoting Mediterranean forest ecosystems at the international level. As one of the oldest statutory bodies of FAO, *Silva Mediterranea* represents a unique platform for exchange in a region that represents 2 percent of the world's forest area but hosts 7 percent of the world's human population.

In the last decade, the restoration of degraded Mediterranean forests and landscapes has gained increasing attention, with activities undertaken in the region continuing to grow substantially at the national and regional levels. In recent years, new environmental and societal challenges have emerged, setting in motion a renewed dynamic involving new actors. These actors implement restoration with a strong research-based focus, participatory planning, better engagement of youth and local communities, and increased efforts on resource mobilization.

In 2017, the countries endorsed the Agadir Commitment, a regional pledge adopted during the First Mediterranean Forest Week held in Agadir, Morocco. The commitment aims to restore 8 million hectares of degraded land by 2030, thereby contributing to the global Bonn Challenge, Sustainable Development Goal 15, the Kunming-Montreal Global Biodiversity Framework and Land Degradation Neutrality. Numerous regional partners, including FAO, the French Facility for Global Environment (FFEM), the German International Climate Initiative (IKI), the European Forest Institute's Mediterranean Facility (EFIMED), the Union for the Mediterranean (UfM) and the United Nations Environment Programme (UNEP), are all supporting it by providing technical and financial assistance to regional actions and projects. This is part of the wider effort to address challenges related to climate change, water scarcity and biodiversity loss in the Mediterranean region. The Agadir Commitment is strengthening collaboration among Mediterranean countries, promoting sustainable land and water management practices, and enhancing the resilience of ecosystems in the face of environmental challenges.

The work of Mediterranean countries to enhance restoration at the national and regional levels was further reinforced by the adoption of the Antalya Declaration, at the Seventh Mediterranean Forest Week in March 2022 in Türkiye, which calls for countries and relevant stakeholders to increase restoration efforts and work with each other to address shared environmental and climate-related challenges.

The launch of the United Nations Decade on Ecosystem Restoration (the "Decade"), co-led by FAO and UNEP, has given fresh impetus to the global restoration movement. The Decade is increasing awareness of the relevance of restoration in the Mediterranean region. In this context, four countries – Lebanon, Morocco, Tunisia and Türkiye – have endorsed the submission to the Decade for the nomination of the Mediterranean region as a World Restoration Flagship. Flagship initiatives are the first, best or most promising examples of successful ecosystem restoration that a country or region would like to be globally known for. The main role of flagships is to provide inspiration to other countries and regions for scaling up successful restoration efforts and to attract global attention and investments.

Due to significant advancements in restoration in the geographic area, the Mediterranean region's nomination as a World Restoration Flagship was successful, and the region will receive targeted support from the Decade to continue to develop specific activities in this field and inspire other countries.

From 4 to 8 November 2024, in Barcelona, Spain, Mediterranean countries, experts and stakeholders will gather at the Eighth Mediterranean Forest Week to discuss the integrated management of Mediterranean forest ecosystems. They will delve into solutions and initiatives for the restoration and sustainable management of these ecosystems to tackle environmental and social challenges.

Together, these regional initiatives form a comprehensive framework that aligns with global sustainability goals, emphasizing the importance of ecosystem restoration in mitigating climate change, conserving biodiversity and promoting sustainable development. This *Unasylva* issue on restoration in the Mediterranean region is an opportunity to showcase the achievements of the Mediterranean community and to demonstrate that the collaboration of nations, organizations and communities is crucial to reaching the ambitious targets set by these initiatives.

We thank everyone who contributed to this edition – especially the FAO secretariat of *Silva Mediterranea* and the Forest and Landscape Restoration Mechanism who initiated and coordinated its production and publication. We look forward to continuing to support the restoration of more Mediterranean forests.

Photo 1. *Silva Mediterranea* country member delegates during a meeting in Dubrovnik, Croatia,1962. In the foreground, Alessandro De Philippis and Riccardo Morandini, from the former Istituto Sperimentale per la Selvicoltura in Arezzo, Italy

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Italian support to the FAO Committee on Mediterranean Forestry Questions – *Silva Mediterranea*: background and current initiatives

Enrico Pompei,[1] Paola Fiore,[2] Giovanbattista de Dato,[3] Giovanni Di Matteo,[3] Lucia Rivera Lima,[3] Silvia Ferlazzo,[1] Marina Vecchio,[1] Fulvio Ducci[2]

[1] Ministry of Agriculture, Food Sovereignty and Forests (MASAF), Italy
[2] Council for Agricultural Research and Economics (CREA), Italy
[3] *Silva Mediterranea*, FAO, Rome, Italy

History of Italian public bodies in forestry

The foundation of the first government department responsible for forestry policy dates back to before the national Italian unification, when the King of Sardinia Carlo Felice issued the Royal Patents on 15 October 1822, establishing an administration to fulfil custodial and management functions for forests.

The State Forestry Corps was founded in 1948, with competencies over the whole national territory. Its mission has remained almost unchanged for two centuries, with broad competencies in the custody, monitoring, protection and management of highlands and woods, as well as the protection of animal and plant species and landscapes, agrifood production control, and the conservation of biodiversity and terrestrial and marine protected areas (see Box 1 on a restoration case study in Italy).

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Photo 2. Meeting of the Working Group on Forest Genetic Resources, Arezzo, Italy, April 2007

Legislative Decree No. 177 dated 19 August 2016 ordered the merger of the State Forestry Corps with the Arma dei Carabinieri and the transfer of almost all competencies to the latter.

In October 2017, following the reform introduced under Article 11, paragraph 2 of the above legislative decree, the General Directorate of Forests (DIFOR) was founded within the Ministry of Agriculture, Food Sovereignty and Forests (MASAF) to adapt the pre-existing ministerial organizational structure and take on some of the roles of the dismantled State Forestry Corps.

Italian support to the FAO Committee on Mediterranean Forestry Questions – *Silva Mediterranea*

In 2018, the Italian Permanent Representation at the United Nations agencies in Rome, and DIFOR expressed their commitment to supporting the secretariat of the Committee on Mediterranean Forestry Questions – *Silva Mediterranea* (hereafter "*Silva Mediterranea*") by seconding two Italian experts to the Forestry Division of FAO.

The ministry mandated a public research institution under its supervision, the Council for Agricultural Research and Economics (CREA), to provide specialist expertise to the secretariat.

CREA is the largest public scientific research institution in Italy, specializing in agriculture, food production and the agrifood industry, fisheries, forestry, food and nutrition, and agricultural economics. A legal person established in the public interest, it has scientific, statutory, organizational, administrative and financial autonomy to achieve its goals within the policy and resources framework set by the ministry.

The mission of CREA is to undertake research and develop technologies to improve the protection and conservation of natural resources and biodiversity within agricultural, forestry and fisheries ecosystems, and increase the efficiency and competitiveness of agricultural, agrifood and forestry activities while ensuring agricultural sustainability and plant and animal health.

CREA engages with international processes to address global challenges, and its researchers provide science-based policy advice in many institutional fora. Together with the other main research institutions based in Rome, such as the National Research Centre (CNR), the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) and the Italian Institute for Environmental Protection and Research (ISPRA), CREA signed a memorandum of understanding with FAO in 2015 to become actively involved in many initiatives and committees. In line with Italy's international engagement on forestry issues, MASAF and CREA play a proactive role in various contexts within FAO.

In 2019, under the ministry's auspices and to further strengthen Italy's commitment to addressing Mediterranean forest-related challenges, CREA made its expertise fully available to the secretariat of *Silva Mediterranea*. Two experts were identified to support it. Giovanbattista de Dato, researcher at CREA's Research Centre for Forestry and Wood, and Giovanni Di Matteo, researcher at CREA's Research Centre for Agriculture and Environment, were seconded to FAO in September 2020.

The support to the secretariat is the natural continuation of Italy's long-standing involvement in *Silva Mediterranea* activities. The country chaired the committee from 1968 to 1970 and has been actively attending its sessions (Photo 1). Italy has also been coordinating the Working Group on Forest Genetic Resources since 1997.

Silva Mediterranea initiatives implemented with the support of Italy since 2020

Silva Mediterranea is a FAO statutory body. Its role is to facilitate participatory dialogue on Mediterranean forests, act as a catalyst to improve their management, propose related calls for action, and address priority topics as advised by its five working groups.

The secretariat of *Silva Mediterranea* coordinates regional capacity-building and knowledge-sharing efforts, and facilitates dialogue and involvement of committee members through designated focal points.

The secretariat is run by all its members, who collectively support it by providing staff in rotation.

Despite the global repercussions of the COVID-19 pandemic, the Italian secretariat ensured continuity in the handover to the French secretariat by managing the regional initiatives (see article by Picard *et al.* on p. 15).

During the Italian mandate, the secretariat of *Silva Mediterranea* led the organization of the Seventh Mediterranean Forest Week (MFW) in Antalya, Türkiye, on 21–25 March 2022.

The theme of the Seventh MFW was "Forest and Ecosystem Restoration for the Next Mediterranean Generations." The event aimed to:

- identify opportunities offered to young people through forest-based solutions in the Mediterranean;
- capitalize on successful experiences combining innovative forest management and local communities, and youth in particular, by sharing such experiences among countries for possible replication;
- promote landscape approaches for Mediterranean forests with a focus on biodiversity restoration and conservation;
- mobilize all stakeholders involved in the integrated management of Mediterranean forests to facilitate the participation of young people in forest-based solutions; and
- build a common vision of the role of young people in the sustainable management of Mediterranean forests in a changing world.

The Antalya Declaration, an outcome of the Seventh MFW, called for countries and relevant stakeholders to increase restoration efforts and work together to address shared environmental and climate challenges. The declaration served to establish a unified approach to Mediterranean forest and landscape restoration initiatives while strengthening the mechanisms currently in place.

The Seventh MFW provided an opportunity for young people working in the Mediterranean forest sector, including in rural settings and through youth organizations, to discuss common challenges and opportunities, showcase success stories and share experiences, good practices and lessons learned for forest and ecosystem restoration. Through a bottom-up approach, it contributed to the participation, recognition and visibility of youth in the forest sector, allowing a unified regional voice to emerge for young people. Their recommendations were shared with high-level practitioners and decision-makers through a youth statement, which also fed into the regional consultations of the XV World Forestry Congress.

All contributions to the Seventh MFW were published in proceedings, including the Antalya Declaration and the Mediterranean Youth Statement.

The secretariat is currently engaged in preparing the Eighth MFW to be held in Barcelona, Spain, on 4–8 November 2024.

The Twenty-Fourth Session of *Silva Mediterranea* was held during the Seventh MFW, with a follow-up at the extraordinary session held in Rome during the Twenty-Sixth Session of the Committee on Forestry (COFO) in October 2022.

Discussions revolved around current and future committee activities, such as the status of the Agadir Commitment 5 years after its adoption, the United Nations World Restoration Flagship submission for the Mediterranean region in the context of the United Nations Decade on Ecosystem Restoration 2021–2030 ("the Decade"), and the *Silva Mediterranea* publications planned for the 2023–2024 period, namely this *Unasylva* special issue on the status of restoration in the Mediterranean, and the new edition of The State of Mediterranean Forests. The working group road maps were also revised and discussed, and a Mediterranean Youth Taskforce was established with key support from the secretariat.

This *Unasylva* special issue focuses on the past 10 years of *Silva Mediterranea* activities. It showcases the status of restoration efforts for Mediterranean forest resources, with an emphasis on recent developments and opportunities for achieving regional and global pledges.

The State of Mediterranean Forests seeks to improve knowledge of forests in the region. The third edition will provide an overview of the status of forest resources based on the latest statistics, and will showcase sound management, nature-based solutions and sustainable socioeconomic initiatives through case studies and good practices.

The newly launched Mediterranean Youth Taskforce aims to promote and guide a regional network of engaged young people aged under 35 years, from or living in the Mediterranean region. Participants are students, researchers and young professionals, or have other active roles in the Mediterranean forest sector (see article by Rivera Lima *et al.* on p. 77).

The secretariat contributed to mobilizing resources for projects related to Mediterranean forests and supported their implementation. The committee's application following the Twenty-Fourth Session of *Silva Mediterranea*, for the Mediterranean region to be recognized as a World Restoration Flagship under the Decade was successful. The initiative will receive a contribution from the Multi-Partner Trust Fund. Activities will be centred on collecting proven good practices for post-fire restoration in the Mediterranean (see article by Romero Montoya *et al.* on p. 30).

Silva Mediterranea contributed to two capacity-building workshops organized at the Mediterranean level as part of the project "The Paris Agreement

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Photo 3. Participants in the COST Action FP1202 summer school field visit, Pieve Tesino, Trento, Italy, September 2015

in Action: Upscaling Forest and Landscape Restoration to Achieve Nationally Determined Contributions" funded by the International Climate Initiative (IKI) (see article by Chnais *et al.* on p. 50):

- The workshop "Carbon Benefits of Forest and Landscape Restoration and Contribution to Nationally Determined Contributions" held in Montpellier, France, on 16–20 May 2022, built capacity on the restoration of degraded Mediterranean forest landscapes, focusing on topics such as the carbon cost and benefits of forest and landscape restoration, and the contribution of forest and landscape restoration to nationally determined contributions (NDCs) under the United Nations Framework Convention on Climate Change (UNFCCC).
- The workshop "Management Practices for the Restoration of Degraded Mediterranean Forest Landscapes", held in Hammamet, Tunisia, on 14–17 March 2023 shared knowledge on restoring degraded Mediterranean forest landscapes, covering topics such as how to assess and plan restoration, which interventions to choose, the role of assisted natural regeneration and forest genetic resources, post-fire restoration strategies, biodiversity recovery and improvement, and financial resources.

Other engaging events on forest restoration hosted or co-hosted by *Silva Mediterranea* included the parallel event "The Flagship Programme in the Mediterranean Region" at the thirteenth conference of the Society for Ecological Restoration Europe held on 5–9 September 2022, in Alicante, Spain; the workshop "Develop, Adopt and Transfer Innovative Solutions and Actions to Prevent and Control Wildfires" with a topic on post-fire restoration in Antalya, Türkiye, on 25–27 October 2022; and a side event on "Restoration Initiatives in the Mediterranean Region" at the Third Session of the COFO Working Group on Drylands Forestry held on 11–14 September 2023 in Jordan.

In addition, *Silva Mediterranea* maintains an active communication channel publishing newsletters and e-alerts on key Mediterranean forestry questions, the main activities of the committee and other relevant issues. A major achievement was the migration and launch of the new *Silva Mediterranea* website,[7] now in three languages – English, French and Spanish – mainly thanks to a voluntary financial contribution from the Government of Spain. The new website serves as a platform for enhancing communication on Mediterranean forestry issues and the work of the committee with partners and members, and for the new online knowledge-sharing "Mediterranean Forestry Network".

The Italian secretariat of *Silva Mediterranea* maintained a collaborative partnership with key regional stakeholders dealing with Mediterranean forests, particularly the European Forest Institute's Mediterranean Facility (EFIMED), the water and environment division of the secretariat of the Union for the Mediterranean (UfM), Plan Bleu, the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), the Mediterranean Model Forest Network (MMFN), the International Association for Mediterranean Forests (AIFM), and the Mediterranean regional office of the International Union for Conservation of Nature (IUCN).

Technical contribution to *Silva Mediterranea's* working groups

Silva Mediterranea works with member country organizations and institutions to examine trends in forest and land use in the region, identify priorities for research, and implement studies and surveys. Member countries share information, technologies, resources and expertise as they work together on topics of mutual interest.

The committee addresses specific technical issues through its working groups, which are subsidiary bodies of *Silva Mediterranea*. Some of the working groups were recently established, while others are the continuation of thematic research networks.

Five working groups are currently active in the following areas:

- forest fires
- cork oak and non-timber forest products
- forest genetic resources
- urban and peri-urban forestry
- desertification and restoration in Mediterranean drylands

Moreover, *Silva Mediterranea* coordinates the scientific board in charge of preparing the third edition of The State of Mediterranean Forests 2024, a textbook that aims to improve knowledge on forest resources in the region, to be launched by the end of 2024.

Italy has been coordinating the Working Group on Forest Genetic Resources for a long time.

Working Group on Forest Genetic Resources

The Research Institute of Forestry and Wood of CREA, formerly the Istituto Sperimentale per la Selvicoltura of Arezzo, began its involvement with *Silva Mediterranea* in 1997 as Italian focal point for forest seed sources and began coordinating the Working Group on Forest Genetic Resources[8] (Photo 2), thanks to the commitment of Fulvio Ducci. The countries participating in the working group are Algeria, Bulgaria, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Morocco, Spain, the Sudan, Tunisia and Türkiye, in cooperation with CIHEAM, the European Forest Genetic Resources Programme (EUFORGEN), and the Working Group 20213 on Mediterranean Conifers of the International Union of Forest Research Organizations (IUFRO).

The CREA institute was mandated by the Twentieth Session of *Silva Mediterranea* held in Sofia, Bulgaria, in 2008 to continue the work of the research network on the selection of Mediterranean conifer stands for the production of seeds used in reforestation programmes, established in 1987 at the Thirteenth Session of *Silva Mediterranea* in Zaragoza, Spain.

In 2011, a survey of the existing FAO experimental network conducted under project FAO 4 bis and others was concluded, and its findings published in a special volume (Besacier *et al.*, 2011) on *Pinus* sect. *halepensis* (*P. halepensis* Mill., *P. brutia* Ten., *P. eldarica* Medw.), *Cedrus* spp. and Mediterranean firs.

In the same period, the French National Institute for Agricultural Research (INRA , now INRAE) compiled the first database of Mediterranean forest genetic resources (FGR) as part of the working group activities.

The Working Group on Forest Genetic Resources then continued its activities from 2012 to 2016 through the COST Action FP1202 "Strengthening Conservation: a Key Issue for Adaptation of Marginal/Peripheral Populations of Forest Trees to Climate Change in Europe (MaP-FGR)". Over 250 researchers from 38 countries and various international organizations, such as FAO, IUFRO and EUFORGEN, participated in this action. Five summer schools were organized with many young scientists (Ducci and Donnelly, 2018; Photo 3). The main outcome of this COST action was the production of a comprehensive database of marginal populations in Europe and the Mediterranean region, as well as many other papers (Fady *et al.*, 2021; Picard *et al.*, 2021, 2022).

The working group attended the Sixth MFW held in April 2019 in Lebanon, and its workplan for 2019–2021 was approved by *Silva Mediterranea* members. The workplan covered a new inventory of Mediterranean FGR, and the development of tools to guide the appropriate choice of genetic resources using the experimental databases and considering adaptation to future climate change scenarios.

This workplan was supported by the international IUFRO Task Force "Strengthening Mediterranean Nursery Systems for Forest Reproductive Material Procurement to Adapt to the Effects of Climate Change".[9] The taskforce aims to establish the foundations of a Mediterranean forest nursery supply chain adapted to new climate change scenarios.

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[7] For more information, see https://www.fao.org/silva-mediterranea/About/afwc-efc-nefc-committee-on-mediterranean-forestry-questions---silva-mediterranea/en

[8] For more information, see https://www.fao.org/silva-mediterranea/working-groups/forest-genetic-resources/en

[9] For more information, see https://www.iufro.org/science/task-forces/mediterranean-nursery-systems/

The working group also continued its activities on marginal populations and FGR in the Mediterranean region under Plan Bleu, supported by France, as well as other funds supported by Spain and the German International Cooperation organization (GIZ).

The working group is currently still led by Italy through Maria Cristina Monteverdi, from the Research Institute of Forestry and Wood of CREA.

The working group presented its activities at several side events at COFO, the MFWs and various conferences, and its outputs served to prepare several publications, some of which are reported in the references section (Ducci and Donnelly, 2018; Fady *et al.*, 2021; Gaisberger *et al.*, 2023; Picard *et al.*, 2021, 2022).

Conclusions

Italy has long supported *Silva Mediterranea* through its commitment to the board and the working groups. Its support to the secretariat of *Silva Mediterranea* is another key role played by Italy within the Mediterranean region.

Italy also has an important role in the FAO International Commission on Poplars and Other Fast-Growing Trees Sustaining People and the Environment (IPC), one of the oldest statutory bodies within the framework of FAO, whose priorities are forest resources production, protection, conservation and utilization, with a view to sustaining livelihoods, land uses, rural development and the environment.

Through all these engagements, the Italian strategies are aligned in supporting the sustainable management of forest ecosystems.

Moreover, the recent approval of the EU Nature Restoration Law, integral to the European Green Deal and the European Biodiversity Strategy, has set the stage for restoring degraded ecosystems, a high priority for *Silva Mediterranea*, the Forest and Landscape Mechanism and FAO's Forestry Division. By supporting the Nature Restoration Law viewed as crucial to halting biodiversity loss and addressing the social and economic challenges of climate change, Italy could further lead as a bridge builder for collaboration and the sharing of efforts under EU strategies.

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Box 1. Restoration efforts in Italy: the Vaia storm case study

This case study shows the Government of Italy's engagement in the restoration of forest resources after a natural disaster, highlighting the country's commitment to the sustainable management and restoration of natural resources.

In October 2018, the Vaia storm hit the northeastern regions of Italy with wind gusts exceeding 200 kilometres per hour and exceptional rainfall in some reliefs of the Alps. Italy's forests suffered serious and extensive damage over about 38 200 hectares across four regions: Trentino Alto Adige, Veneto, Friuli Venezia Giulia and Lombardia. The stock volume of fallen trees was about 16.5 million cubic metres.

This hugely destructive storm recognized as the most damaging windthrow event ever recorded in Italy, severely impacted the multifunctional role of forests and caused increased exposure to falling boulders, landslides and avalanches due to the lack of slope protection; a higher risk of forest fires from increased levels of deadwood; pest damage; and economic losses along the wood supply chain.

In the aftermath of the storm, the General Directorate of Mountain Economy and Forestry of MASAF partnered with local authorities and forestry research organizations for an initial assessment of the damage caused by Vaia in all the regions affected.

At the local level, each municipality adopted a different mapping method based on on-site surveys, aerial observations, and the use of remote piloting systems and satellite imagery.

All data were collected and harmonized to a common standard to create a forest damage inventory. The results obtained served as a starting point for the first interventions in the field and forest restoration planning.*

MASAF funded specific interventions for the restoration of forest infrastructure and hydrogeological risk mitigation, and for monitoring biological changes in the affected areas in the post-disturbance phase.

As a further and direct consequence of the storm, the forests hit by Vaia were affected by the massive spread of the Norway spruce bark beetle (*Ips typographus* L.), causing an additional loss of forest resources. Given the environmental conditions particularly favourable for the spread of the bark beetle, the insects attacked not only the felled trees but also the standing ones.

This large-scale pest attack, which is still threatening millions of trees in northern Italy, required a specific monitoring framework on infested areas based on combining remote sensing and field survey detection to investigate bark beetle dynamics and mitigate further spreading. Mapping of the infested areas is currently in progress.

Several studies are currently being conducted 5 years after the Vaia disaster with the purpose of assessing its impact and understanding ongoing changes in the forest ecosystem.

Information about natural forest renewal and the abundance of some indicator-insect families and orders was collected. Early results showed that natural dynamics were fully functional. The sampled sites showed that the variety of plants and arthropod communities was significantly higher in the "windthrow sites" than in other "control sites" unaffected by Vaia, highlighting reasonable improvement in biodiversity after the storm.

The monitoring also focused on the grazing damage and its impact on degraded forest regeneration.

This collaborative work highlighted the importance of the monitoring activity carried out in the degraded areas from 2020 to 2023, and the relevance of the collected data, which are valuable at a broader geographical level. The bark beetle outbreak made this monitoring activity even more urgent.

For a better forest management strategy, long-term monitoring will be essential, allowing learning about how to enhance the resilience and adaptation of forest ecosystems to abiotic and biotic disturbance events that will be more frequent and more severe in the future due to climate change.

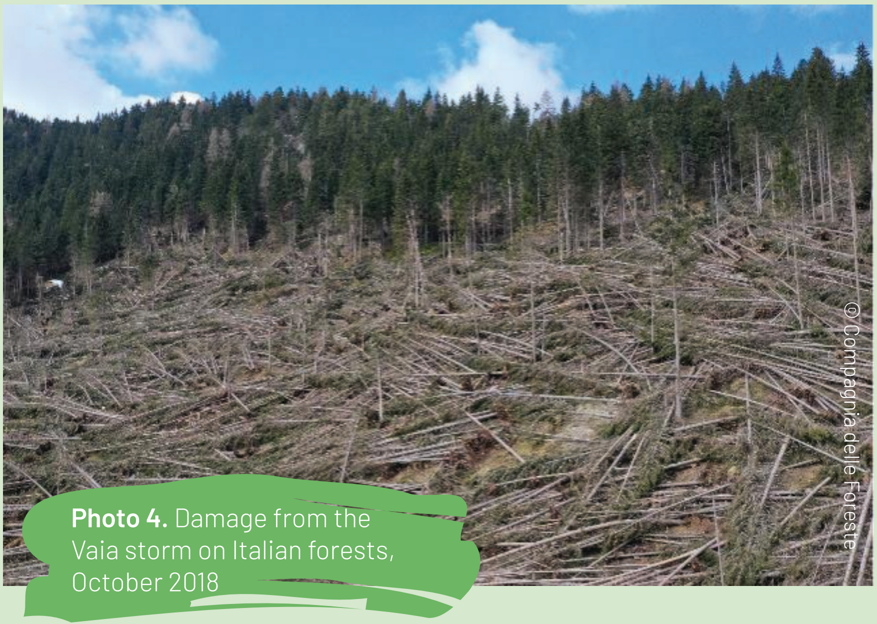
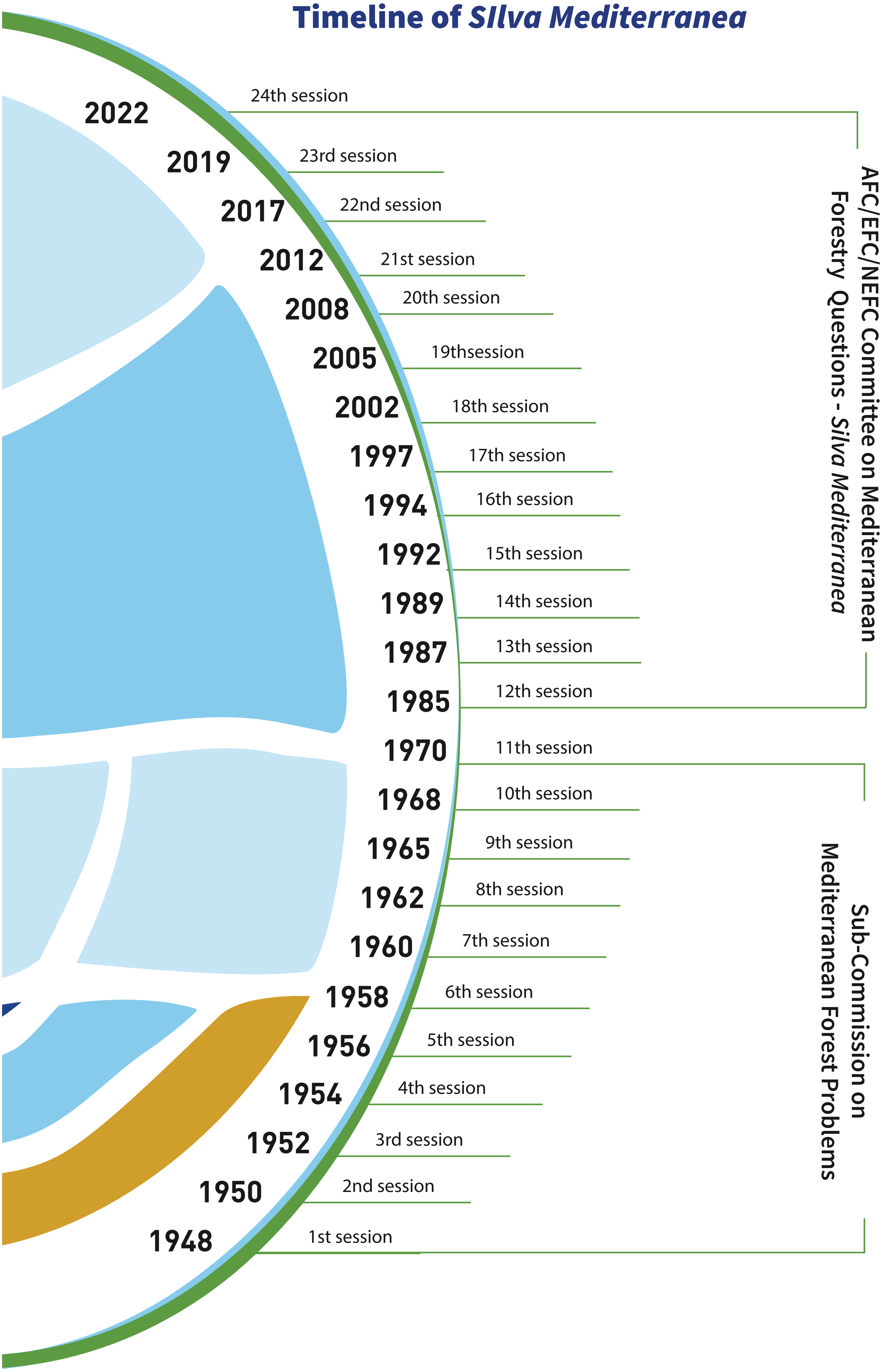


Photo 4. Damage from the Vaia storm on Italian forests, October 2018

© Compagnia delle Foreste

Note: * See "Mappatura delle superfici forestali danneggiate dalla tempesta Vaia" in https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/18158

Timeline of *SIlva Mediterranea*


2022
24th session
2019
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2017
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2012
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AFC/EFC/NEFC Committee on Mediterranean Forestry Questions - *SIlva Mediterranea*
Sub-Commission on Mediterranean Forest Problems

A decade of French support to Mediterranean forests

© Léa Tardieu

The Fenouillet trail, Cavalaire-sur-Mer, France

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Introduction

In 2005, the tenth anniversary of the Euro-Mediterranean Partnership, also known as the Barcelona Process, highlighted the need to revitalize the dialogue on regional cooperation in the Mediterranean basin. The political will to do so led to the creation of the Union for the Mediterranean (UfM) at the Paris Summit for the Mediterranean in July 2008. This political commitment to cooperation throughout the region on stability, inclusive development and integration also had an impact in the environmental field. In particular, France reinforced its support to bodies dealing with both marine and terrestrial Mediterranean ecosystems. For the former, stronger support was provided to Plan Bleu, one of the regional activity centres of the Mediterranean Action Plan (MAP) of the United Nations Environment Programme (UNEP). For the latter, two experts from the French Ministry of Agriculture were successively seconded to FAO to support the activities of the Committee on Mediterranean Forestry Questions – *Silva Mediterranea* (hereafter "*Silva Mediterranea*"). This support to *Silva Mediterranea* lasted just over a decade, from November 2009 to May 2020.

Silva Mediterranea, which is the continuation of an association created in 1922, has a long history of Mediterranean cooperation in the forest sector. Over such a long period, the committee had to keep reinventing itself and evolving to adapt to new challenges. In 2002, the future of *Silva Mediterranea* was the main topic on the agenda of the eighteenth session of the committee. Based on an external review of the committee and its networks, a number of changes were recommended to reinvigorate it. The French support to the secretariat of *Silva Mediterranea* came just after these recommendations. Between 2009 and 2020, four presidents chaired the committee and supervized this revitalization process: Spas Todorov from Bulgaria, İsmail Belen from Türkiye, José Manuel Jaquotot Sáenz de Miera from Spain and Chadi Mohanna from Lebanon.

By the end of the 2000s, climate issues had already been incorporated into the agenda on Mediterranean forests. The Mediterranean ecosystems are located between arid and temperate biomes and are highly vulnerable to climate change, which is likely to result in their limits moving northwards. The issue of desertification in the Mediterranean and the role of forest ecosystems as a barrier to degradation processes was raised as early as the 1980s. Furthermore, Mediterranean forests are distinct in that wood is just one among many other goods and services provided and used by the forest sector and local communities. This interplay between diverse forest uses that contribute to rural development and global changes has given even more importance to the role that Mediterranean forests can play in the bioeconomy.

This article aims to review the activities that have been implemented between 2009 and 2020 under *Silva Mediterranea* to support Mediterranean forests. Starting from an agenda dominated by climate issues, this decade has seen the emergence of forest and landscape restoration (FLR) as a way of addressing climate change challenges while simultaneously reaching several other key objectives.

Revitalizing the dynamic around mediterranean forests

Developing a strategic agenda on Mediterranean forests

From the early 2010s, it became clear that the revitalization of the regional agenda on Mediterranean forests required strategic direction to set priorities and coordinate efforts. The development of a strategic agenda on Mediterranean forests was initiated at a workshop in Ramatuelle, France, in November 2011 and continued in 2012–2013 through several meetings in Chania, Greece, Rome, Italy and Tlemcen, Algeria. The resulting Strategic Framework on Mediterranean Forests (SFMF) was endorsed by Mediterranean countries at the high-level segment of the Third Mediterranean Forest Week (MFW) in Tlemcen in March 2013 (Besacier, 2013).

The SFMF set three goals and defined nine strategic approaches for reaching them. The first goal was to develop and promote forests by (1) improving the sustainable production of goods and services by Mediterranean forests, (2) enhancing the role of Mediterranean forests in rural development, and (3) promoting forest governance and land-tenure reforms at the landscape level. The second goal was to promote resilience under global changes by (4) promoting wildfire prevention, (5) managing forest genetic resources and biodiversity to enhance the adaptation of Mediterranean forests, and (6) restoring degraded Mediterranean forest landscapes. The third goal was to enhance capacities and mobilize resources by (7) developing knowledge, training and communication on Mediterranean forests, (8) reinforcing international cooperation, and (9) adapting existing financing schemes and developing innovative funding mechanisms.

Hence, the restoration of degraded forest landscapes was already considered a priority for the Mediterranean region in the SFMF. Restoration was seen as an answer for addressing desertification in the context of climate change while enhancing environmental and cultural services and strengthening food security and livelihoods. An integrated, long-term approach to restoration at the landscape level was already being advocated.

The SFMF echoed and aligned with several governmental policies on forests in Mediterranean countries, particularly in North Africa and the Near East (Mokhtar, 2014). For instance, in the second half of the 2010s, Algeria initiated a revision of several sustainable management plans for forested landscapes, to deal with increased vulnerability to climate change and existing degradation due to a lack of natural regeneration, and overgrazing. The restoration of cork oak landscapes was elevated to a priority. In Lebanon, a national afforestation and reforestation programme to increase the forest area from 13 percent to 20 percent of the country's land area was initiated at that time, in line with the SFMF. In Portugal, the National Forest Strategy adopted in 2015 tackled 60–70 percent of the SFMF's recommendations (Farcy and Picard, 2015).

The SFMF was also the basis for the development of *Silva Mediterranea*'s strategy, adopted at its twenty-third session in Brummana, Lebanon, in April 2019 and which focused on the restoration of forest landscapes.

Engaging with stakeholders on Mediterranean forests

The implementation of the SFMF required strong multi actor engagement. As early as 2009, the idea of a platform to foster interactions between stakeholders grew as a means of fulfilling the objectives of the strategic agenda on Mediterranean forests, regularly monitoring progress in the implementation of this agenda, and coordinating countries' efforts and allowing them to share experiences. This platform for stakeholder dialogue and engagement was established along with the MFWs, which are still being regularly organized. From 2009 to 2019, six MFWs were hosted. The First MFW took place in Antalya, Türkiye, from 14 to 16 April 2010. This First MFW, mainly a combination of several meetings, confirmed the need for a regional consultation platform on Mediterranean forests. It also set the format for subsequent MFWs, with a wide range of participant profiles from government, science and academia, and non-governmental and international organizations.

The Second MFW held in Avignon, France, from 5 to 8 April 2011, focused on forest-related water issues, management and conservation of forest biodiversity, territorial approaches to local development based on forests, and wildfire prevention.

The Third MFW, which took place in Tlemcen, Algeria, from 17 to 21 March 2013 was a turning point in the MFWs, with the involvement of high-level representatives from Mediterranean governments. For the first time, there was a direct connection between the Mediterranean forests agenda developed by all stakeholders and the political commitments of Mediterranean countries. The Third MFW focused on sustainable development in rural areas, the value of goods and services provided by Mediterranean forests, and the mitigation and adaptation strategies of specific areas in the face of global changes. It culminated with a high-level segment where the SFMF was formally endorsed by Mediterranean countries in the Tlemcen Declaration. More than 230 participants attended the Third MFW.

The growing success of the MFWs was confirmed with the Fourth MFW in Barcelona, Spain, on 17–20 March 2015, which registered more than 420 participants. The Fourth MFW focused on forest value chains in the Mediterranean region as a way of

State of Mediterranean Forests 2013
Food and Agriculture Organization of the United Nations
UN environment
Plan Bleu
State of Mediterranean Forests 2018

The 2013 and 2018 editions of the State of Mediterranean Forests, a series of reports developed collaboratively to provide a regional view on Mediterranean forests

Sources:

FAO & Plan Bleu. 2013. *State of Mediterranean forests 2013*. Rome, FAO and Marseille, France, Plan Bleu. https://www.fao.org/4/i3226e/i3226e.pdf

FAO & Plan Bleu. 2018. *State of Mediterranean Forests 2018*. Rome, FAO and Marseille, France, Plan Bleu. https://openknowledge.fao.org/items/25b72969-96f1-4af8-885b-40e2a07995a1

improving livelihoods and moving towards a bioeconomy.

Mediterranean FLR was the main topic of the Fifth MFW, which took place in Agadir, Morocco, on 20–24 March 2017. During the high-level segment that concluded the MFW, ten countries adopted the Agadir Commitment to improve FLR, Land Degradation Neutrality (LDN) and biodiversity conservation efforts in the Mediterranean region, with a view to restoring at least 8 million hectares of degraded land by 2030 (i.e. 10 percent of the degraded land in the region). This commitment was supported by several international organizations and contributed to the Bonn Challenge. It relied on four main components: (1) assessing ongoing national efforts on FLR; (2) reinforcing regional cooperation on FLR and LDN; (3) cooperating to develop a consensual and diversified strategy for the financing of FLR efforts and reinforcing national capacities; and (4) assessing efforts through the establishment of a voluntary monitoring and notification system for FLR and LDN efforts in the Mediterranean context.

The Sixth MFW held in Brummana, Lebanon, on 1–5 April 2019 focused on the role of Mediterranean forests in the Paris Agreement. It established a framework for Mediterranean forests to contribute to fulfilling the countries' nationally determined contributions, in combination with the Agadir Commitment. The Sixth MFW also highlighted the importance of youth education and entrepreneurship to address the challenges faced by Mediterranean forestry.

Consolidating knowledge on Mediterranean forests

The development of the SFMF also brought to light the need for systematic consolidation of knowledge on Mediterranean forests to inform public policies based on the latest scientific knowledge and insights on Mediterranean forests. The State of the World's Forests report published by FAO and the State of Europe's Forests report published by Forest Europe were already providing information on forests at the global and European level, but there lacked a report specific to the Mediterranean region.

The first State of Mediterranean Forests report was published in 2013. Using data from the FAO 2010 Global Forest Resources Assessment (FRA) and other data sources, this report provided the first consolidated account on forests at the regional level. It consisted of three main parts: (1) the status of forest resources, (2) the legal, policy and institutional framework, and (3) forest adaptation to climate change. The report addressed the extent of forest resources in the Mediterranean region, disturbances faced by forests, goods and services provided by forest ecosystems, forest management policy and legal frameworks, public policies, biodiversity and forest genetic resources, adaptive management and restoration practices, and wildfire prevention.

The second edition of the State of Mediterranean Forests was published in 2018. The report covered (1) the importance of forests in the Mediterranean landscape together with the threats that they face, (2) forest-based solutions that can be implemented to tackle these threats, and (3) the enabling environment needed to scale up these solutions. Using FRA 2015 data, the report outlined the changes in forest resources in the 2010–2015 period. Besides forests, the importance of trees outside forests was also highlighted. Drivers of forest degradation were identified. Forest and landscape restoration was identified as a process with high potential for the region. The report also described the role that Mediterranean forests can play in the bioeconomy, provided an analysis of policy documents guiding forest management, and underlined the relevance of participatory approaches for implementing solutions in the region.

In addition to the State of Mediterranean Forests, several summary reports and articles were published during the 2009–2020 decade to provide a regional view on topics like the vulnerability of forest ecosystems to climate change, the distribution ranges of Mediterranean tree species (Wazen *et al.*, 2020), and the role of Mediterranean forests in contributing to reaching the United Nations Sustainable Development Goals (Picard and Garavaglia, 2021).

Giving new impetus to cooperation on forests at the level of the North Africa and Near East region

Mediterranean countries had different priorities with regard to their forests. A north–south dichotomy existed whereby forest degradation (in particular, due to overgrazing) was a major issue for countries of the North Africa and Near East region region, whereas land abandonment and lack of management were major challenges for European countries. Moreover, the need for coherent policies, improved knowledge, increased public awareness and adequate funding differed along this north–south gradient. Consequently, in 2010, the Collaborative Partnership on Mediterranean Forests (CPMF) was established between ten international and northern organizations and six targeted countries from North Africa (Algeria, Morocco, Tunisia) and the Near East (Lebanon, the Syrian Arab Republic, Türkiye). Two additional partners joined the CPMF in 2012.

The main objective of the CPMF was to improve the policy framework for the sustainable management of forests and related ecosystem services in the context of climate change in the six selected countries. The CPMF mobilized EUR 10.5 million from its inception to November 2015, the greatest share of this (70 percent) being provided by the German Federal Ministry for Economic Cooperation and Development (BMZ) through projects operated by the German International Cooperation organization (GIZ). The main project implemented by GIZ under the CPMF was a regional project entitled "Adapting the Framework for Forestry Policy to Meet the Needs of Climate Change in the North Africa and Near East Region". This project was key for revitalizing long-term regional cooperation on forestry questions in the six targeted countries and elevating this subregional process to the Mediterranean level. Another major project of the CPMF was funded by the French Facility for Global Environment (FFEM) (see below).

The CPMF also supported action that extended beyond the six targeted countries to the entire Mediterranean region, by developing the SFMF, the 2013 edition of the State of Mediterranean Forests and the first three MFWs. When the GIZ regional project ended in November 2015, the North Africa and Near East region cooperation on forests aligned with the Mediterranean cooperation, and the CPMF's work programme was integrated into that of *Silva Mediterranea*.

From planning to action

Supporting the working groups of Silva Mediterranea

The priorities set in the SFMF were turned into action via several working groups of *Silva Mediterranea*. The Working Group on **Forest Fires** coordinated by Spain organized a workshop on "Assessment of Forest Fire Risks and Innovative Strategies for Fire Prevention" in Rhodes, Greece, in May 2010. The outcome of this workshop and of a previous workshop held in 2008 was condensed into a position paper entitled "Wildfire prevention in the Mediterranean: a key issue to reduce the increasing risks of Mediterranean wildfires in the context of climate change", published in 2011. The working group also facilitated the extension of the European Forest Fire Information System (EFFIS) to the countries of the southern Mediterranean shore. The working group hosted another workshop in November 2018 in Leon, Spain. Its outcome was a statement on wildfires in the Mediterranean region presented at the 2019 International Wildland Fire Conference.

Until 2016, the Working Group on **Forest Genetic Resources** coordinated by Italy implemented its programme of work through COST Action FP1202, entitled "Strengthening Conservation: a Key Issue for Adaptation of Marginal/Peripheral Populations of Forest Trees to Climate Change in Europe". This project focused on marginal forest tree populations as a key genetic asset for improving the resilience of European forests to global changes. The project characterized the genetic diversity and geographic distribution of marginal populations for eight Mediterranean tree species. Its main conclusions were summarized in a policy brief published in 2015 (Core Group of COST Action FP1202, 2015). Given the importance of having forest reproductive material available, the working group then refocused its work programme on an inventory of Mediterranean seed stands and in 2019 established an International Union of Forest Research Organizations (IUFRO) Task Force on "Strengthening Mediterranean Nursery Systems for Forest Reproductive Material Procurement to Adapt to the Effects of Climate Change".

The Working Group on **Cork Oak and Non-Timber Forest Products** promoted the development of cork oak by participating in conferences and symposia, while the Working Group on **Mediterranean Forests and Sustainable Development** supported the writing-up of the State of Mediterranean Forests report and the organization of the MFWs. Two additional working groups were established in 2012: one on urban and peri-urban forestry coordinated by Italy, and the other one on restoration and desertification of drylands coordinated by Türkiye.

The Working Group on **Urban and Peri-urban Forestry** published a systematic review on urban forest research in the Mediterranean (Krajter Ostoić *et al.*, 2018), developed a COST Action project proposal on "Implementing Food Forest Systems in the Mediterranean Region", drafted a policy brief on urban forestry in the Mediterranean, developed a list of indicators for the assessment of the state of urban and peri-urban forests in the Mediterranean, and lastly, developed a collection of case studies and good practices on urban and peri-urban forestry in the Mediterranean region. This working group was active in promoting the experiences of the Mediterranean region on urban and peri-urban forestry at the global level.

The Working Group on **Restoration and Desertification of Drylands** organized a workshop on "Desertification and Restoration in Mediterranean Drylands" at the twelfth Conference of the Parties of the United Nations

Convention to Combat Desertification (UNCCD) in October 2015 in Ankara, Türkiye, promoted the issue of restoring Mediterranean drylands at the international level, supported the Agadir Commitment taken at the Fifth MFW, participated in the global assessment of forests in drylands (Bastin *et al.*, 2017; FAO, 2019), and lastly, contributed to two reference books on the restoration of degraded dryland forests and landscapes (Berrahmouni, Regato and Parfondry, 2015; Haddad, Ariza and Malmer, 2021).

Implementing regional projects

The activities of the *Silva Mediterranea* working groups were complemented by regional projects coordinated by the committee's secretariat. A regional project funded by the FFEM started in 2012. Entitled "Optimizing the Production of Goods and Services by Mediterranean Forests in the Context of Global Changes" and co-coordinated with Plan Bleu, this project aimed to (1) integrate the impacts of climate change into forest management policies (by producing data and tools on the vulnerability and adaptive capacity of forests); (2) estimate the economic and social value of the goods and services provided by Mediterranean forest ecosystems; (3) improve forest ecosystem governance approaches at the local level by promoting participatory approaches; (4) optimize and enhance the mitigation role of Mediterranean forests (carbon sinks) through the development of methodological tools that enable the promotion of local efforts to protect or restore ecosystems; and (5) strengthen coordination and sharing of experiences among actors by supporting the CPMF.

The FFEM regional project relied on eight pilot sites in five North Africa and Near East countries, namely the target countries of the CPMF, except the Syrian Arab Republic. The project mainly aimed to explore the potential of Mediterranean forests to mitigate climate change under the REDD+ mechanism. Together, the first three components of the project aimed to contribute to developing REDD+ scenarios that could be implemented in the target countries, while the fourth component focused on evaluating the impact of REDD+ projects in the context of each scenario. However, the project found that the REDD+ mechanism was of limited interest for Mediterranean countries unless co-benefits were produced alongside carbon benefits. Nevertheless, the project helped the target countries carve out a role for forests in their national climate strategies, in particular with regard to adaptation to climate change (FAO, 2015; Torres and Martinet, 2016). The project also enabled the countries to identify FLR a major tool to reach climate objectives in the region.

Subsequent regional projects focused specifically on FLR. As part of the development of the seventh replenishment cycle of the Global Environment Facility (GEF) and its Impact Program on Food Systems, Land Use and Restoration, a Technical Cooperation Program (TCP) project entitled "Enhancing Forest and Landscape Restoration in Mediterranean Landscapes: Improving Resilience for the Benefit of People and Environment" was set up by FAO. The objective of this TCP project was to develop GEF project proposals in Algeria, Egypt, the Islamic Republic of Iran, Jordan, Lebanon, Morocco, the Sudan and Tunisia.

Another regional project focusing on FLR was the Mediterranean component of the IKI-funded project "The Paris Agreement in Action: Upscaling Forest and Landscape Restoration to Achieve Nationally Determined Contributions", developed by the Forest and Landscape Restoration Mechanism of FAO.

Conclusion

A decade of French support to Mediterranean forests under the FAO committee *Silva Mediterranea* has resulted in establishing strategic approaches for Mediterranean forests, improving stakeholder engagement, consolidating information on Mediterranean forests, and developing and implementing several regional projects in line with the priorities set out under the SFMF. One key priority that emerged during this decade is the restoration of forest landscapes in the Mediterranean. Current developments both at the regional level (e.g. the EU proposal for a Nature Restoration Law) and global level (e.g. the United Nations Decade on Ecosystem Restoration) have confirmed its relevance and have resulted in the Mediterranean region being nominated as a World Restoration Flagship in the context of the United Nations Decade on Ecosystem Restoration.

Moreover, this decade has resulted in stronger connections between climate and restoration objectives involving Mediterranean forests. In the context of global change, the features of Mediterranean forests make them particularly relevant to implementing good restoration practices. Many Mediterranean forests are degraded, thus offering large restoration opportunities. The balanced distribution of the value of Mediterranean forests across a wide range of goods and services, while other, more productive forest ecosystems often have a narrower distribution peaking on wood products, make Mediterranean forests particularly relevant for landscape approaches. However, there is still a dichotomy between the northwestern and southeastern shores of the Mediterranean that needs to be resolved, requiring efforts on regional integration to be maintained and reinforced.

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Restoration in the Mediterranean, a journey towards renewal: the converging and interlinked agendas of the Union for the Mediterranean

Alessandra Sensi, Laurent Alfonso, Anna Dorangricchia, Giuseppe Provenzano, Doha Zamel, Yasmine Kefti

Union for the Mediterranean (UfM)

The Union for the Mediterranean at a glance

The Union for the Mediterranean (UfM) is an intergovernmental Euro-Mediterranean organization that includes 43 members: all 27 countries of the European Union and 16 countries of the south and east of the Mediterranean. The UfM was created in 2008 as a direct continuation of the Barcelona Process and seeks to reaffirm the political ambition to strengthen regional cooperation in the Euro-Mediterranean area. The organization is based on the principle of co-ownership with regard to the two subregions of the Mediterranean basin, embodied by the co-presidency of the European Union and Jordan since 2012.

Based in Barcelona, Spain, the UfM secretariat implements the decisions taken at the political level. It organizes regional and subregional sectoral dialogues and follow-up activities to facilitate progress in the implementation of ministerial commitments and to promote collaborative initiatives in the region. Its multipartner approach is crucial for creating opportunities to exchange best practices, share experiences, identify new methodologies, and develop regional and subregional networks.

Mission

The UfM's primary mission is to enhance cooperation, dialogue, integration, stability and sustainable development at the regional level through the implementation of projects and initiatives with tangible impacts (Figure 1). The UfM's approach is to establish effective links between policies and their operational translation into concrete projects and initiatives on the ground addressing the region's key challenges and priorities. This approach consists of three components:

- political fora
- regional platforms
- regional projects

The political dimension of the UfM is structured around meetings of ministerial and governmental representatives establishing the framework for the UfM's work through the adoption of agendas in key strategic areas.

The Union for the Mediterranean label

The UfM label is awarded to **regional cooperation projects by unanimous decision** of the 43 member states. The label supports project ownership and visibility on a regional scale, encourages the extension of activities to other Mediterranean countries, and the funding, communication and dissemination of best practices, thereby embedding the project into the wider UfM processes and agendas.

Since 2012, over 60 regional cooperation projects with a budget of more than EUR 5 billion have been granted the UfM label, 30 of which have been completed.

The UfM-labelled Mediterranean component of the "Paris Agreement in Action" project

With a total budget of EUR 1.85 million over a 4-year period, the Mediterranean regional component of the project funded by the International Climate Initiative (IKI) of the German Federal Ministry for Economic Affairs and Climate Action and implemented by the FAO Forest and Landscape Restoration Mechanism (FLRM), was labelled by the 43 UfM member countries in 2018. The project aims to build regional and national capacity for the implementation of large-scale forest and landscape restoration (FLR) programmes, with Lebanon and Morocco as key focus countries. Through pilot activities applying appropriate FLR approaches, the project aims to contribute to the achievement of national and global restoration targets such as nationally determined contributions, Aichi targets, the Bonn Challenge and Sustainable Development Goals (SDGs), and major carbon and non-carbon benefits for water, biodiversity and livelihoods.

Restoration underpins the transition towards the circular bioeconomy: pooling political, technical and financial resources around the UfM 2030GreenerMed agenda

The UfM agenda "Towards 2030: Agenda for a Greener Med – Contributing to Achieving the Environmental SDGs in the Mediterranean" ("2030GreenerMed") directly supports the implementation of the Second UfM

Figure 1. Structure and mission of the Union for the Mediterranean

The UfM at a glance

43 members

27 EU members and 15 Southern and Eastern Mediterranean countries. Their senior officials meet regurarly to oversee and coordinate the activites of the UfM

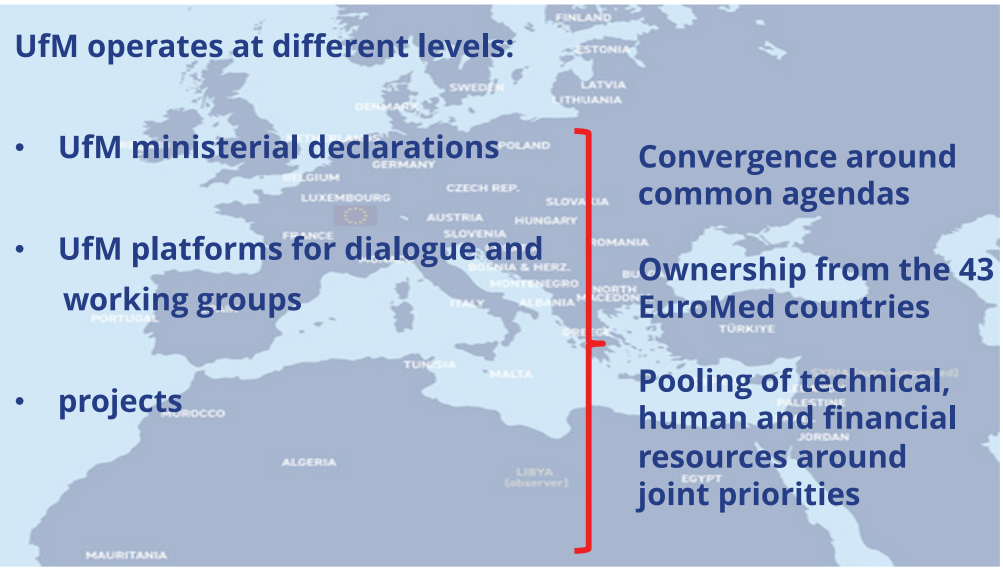
2 co-presidents

The Eu and Jordan have assumed the northern and southern co-presidency since 2012, embodying the UfM principle of co-ownership

1 secretariat

Based in Barcelona, Spain, the secretariat is the operational platform of the UfM

*Mission to enhance **cooperation, dialogue integration, stability and sustainable development at regional level** through the implementation of concrete projects and initiatives with tangible impacts*



UfM operates at different levels:

- **UfM ministerial declarations**
- **UfM platforms for dialogue and working groups**
- **projects**

Convergence around common agendas

Ownership from the 43 EuroMed countries

Pooling of technical, human and financial resources around joint priorities

Thematic Axis 1

Support the transition towards a green, circular and socially inclusive economy, based on sustainable consumption and production practices and nature-based solutions

Thematic Axis 2

Prevent and reduce pollution on land, air and sea

Thematic Axis 3

Protect, preserve and restore natural resources in the Mediterranean region within an integrated ecosystem approach, including terrestrial, marine and coastal dimensions

Figure 2. The Union for the Mediterranean's strategic directions or thematic areas

Ministerial Declaration on Environment and Climate Action, adopted by the 43 UfM member countries in Cairo, Egypt, on 4 October 2021. In keeping with the key thematic priorities of the first ministerial declaration in 2014, the second declaration aims to reconcile tackling urgent environmental and climate issues and economic development. The declaration promotes greater sectoral integration and aligns its priorities and goals with the 2030 Agenda and related SDGs, the Rio Conventions and related post-2020 frameworks, as well as key international and regional conventions and frameworks.

The 2030GreenerMed agenda provides a structured regional framework to coordinate existing and future programmes and projects, and foster political and operational convergence to accelerate the transition of the Mediterranean region towards a circular bioeconomy and a more sustainable model of development. Conceived as a joint flagship agenda by and for all stakeholders in the Mediterranean region, it is owned, steered and developed by countries together with partner organizations.

The UfM secretariat supports the agenda through various collaboration tools, including tecΩhnical assistance and regional meetings, to pool political, technical and financial resources around the agreed priorities. 2030GreenerMed is structured around the three thematic areas shown in Figure 2.

These three thematic areas or strategic directions are closely interlinked and need to be addressed simultaneously. Each one has been broken down into a series of key actions identified by the UfM member states, stakeholders and donors for easy communication and follow-up (for example, Figure 3). In addition, climate mitigation and adaptation are integrated as a high-priority cross-cutting theme. Education on sustainable development is also a cross-cutting theme, targeting women and youth in particular.

The 2030GreenerMed agenda is supported by a monitoring and reporting framework based on a theory of change linked to the SDGs.

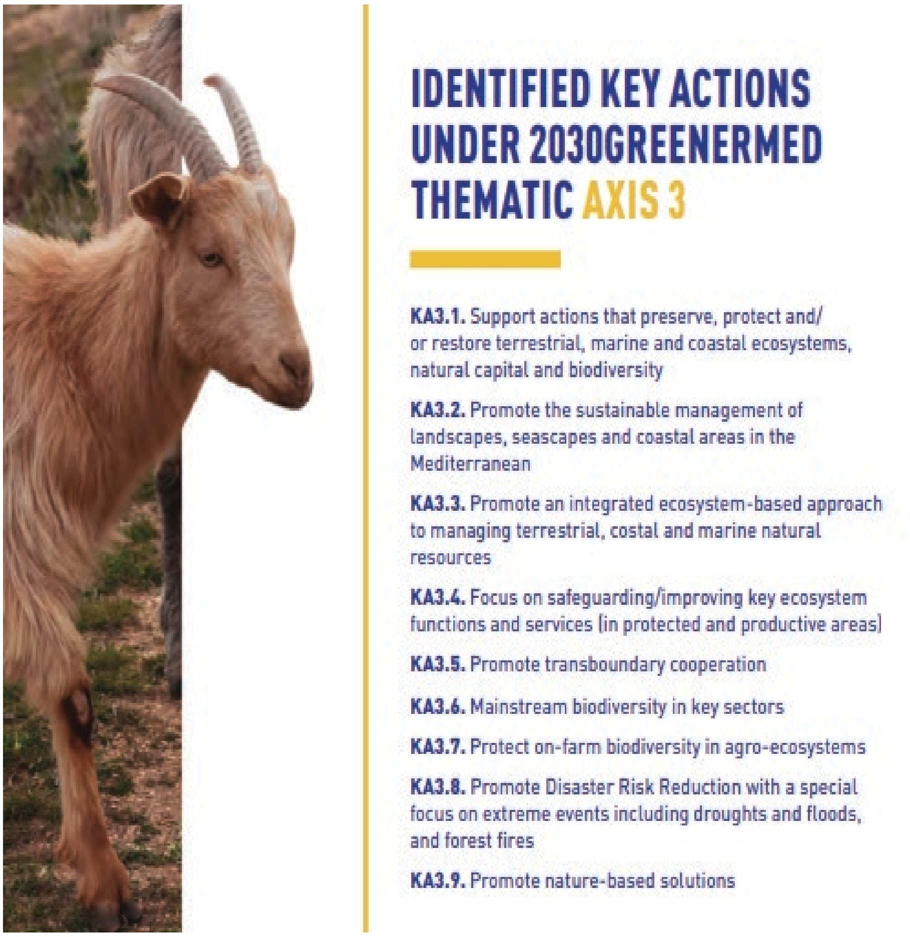
Forest and landscape restoration in the UfM 2030 GreenerMed agenda

The Mediterranean region includes over 80 million hectares of degraded land. More than 400 000 hectares of forests are burnt each year, and at least 16 animal and plant species in Mediterranean forests are at risk of extinction, due to environmental threats exacerbated by climate change.

Forests play a key role in providing and protecting ecosystem services and biodiversity. The maintenance of healthy forested landscapes is essential for reducing the impacts of climate change. Effective planning, implementation and monitoring of large-scale programmes mainstreaming FLR and promoting joint mitigation and adaptation approaches are crucial for achieving climate and restoration goals in the Mediterranean region.

Together with wetlands and marine protected areas, FLR is central to the third thematic area of 2030GreenerMed, complementing and reinforcing conservation and management action.

The UfM collaborates with FAO on FLR, in particular through the



IDENTIFIED KEY ACTIONS UNDER 2030GREENERMED THEMATIC AXIS 3

KA3.1. Support actions that preserve, protect and/or restore terrestrial, marine and coastal ecosystems, natural capital and biodiversity

KA3.2. Promote the sustainable management of landscapes, seascapes and coastal areas in the Mediterranean

KA3.3. Promote an integrated ecosystem-based approach to managing terrestrial, costal and marine natural resources

KA3.4. Focus on safeguarding/improving key ecosystem functions and services (in protected and productive areas)

KA3.5. Promote transboundary cooperation

KA3.6. Mainstream biodiversity in key sectors

KA3.7. Protect on-farm biodiversity in agro-ecosystems

KA3.8. Promote Disaster Risk Reduction with a special focus on extreme events including droughts and floods, and forest fires

KA3.9. Promote nature-based solutions

Figure 3. Key actions identified under the UfM's third thematic area

Mediterranean regional component of "Paris Agreement in Action: Upscaling Forest and Landscape Restoration to Achieve Nationally Determined Contributions" project.

The 2030GreenerMed agenda promotes coordination and ensures complementarity of Mediterranean FLR efforts with other agendas and activities, such as:

- the UfM civil protection agenda on disaster preparedness, the UfM research and innovation agenda on health, renewables and climate change, and the UfM women and youth agenda, which is mainstreamed across all UfM focus areas;
- PRIMA[10] activities on nature-based solutions to enhance ecosystem resilience to climate change and help accelerate the transition towards more sustainable agrifood systems through agroecological measures such as crop combinations, agroforestry and mixed crop-livestock systems;
- the Platform for Sustainable Food Systems in the Mediterranean, jointly run by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), FAO, the UfM, PRIMA and One Planet, to foster multistakeholder dialogue and collaboration, strengthen knowledge sharing and capacity building, and create opportunities for regional cooperation among Mediterranean countries and public and private actors to drive the transformation towards sustainable food systems in the Mediterranean region;
- the European Forest Institute's Mediterranean Facility (EFIMED), which aims to harness the forest sector's untapped potential for achieving a global bioeconomy through collaborative research to create sustainable value from Mediterranean forested landscapes; and
- the United Nations Convention to Combat Desertification (UNCCD), in which the UfM holds an observer status.

Combining restoration with preparedness: the UfM civil protection agenda

According to the literature, disaster risk management is an iterative process consisting of several steps to anticipate an event (prevention), prepare for it (preparation), respond to it (response) and recover from it (restoration). The four phases of the disaster risk management cycle (Figure 4) are interrelated. For example, linking preparation and restoration, and vice versa, is particularly useful because planning, implementing and monitoring restoration allow to integrate lessons learned "for the best" (think: "Build Back Better") or reflect on how to better prepare. In this context, the UfM regional dialogue platform on civil protection focuses on building synergies by sharing knowledge and good practices across the Euro-Mediterranean area.

The people responsible for preparedness and restoration typically operate within separate spatial and temporal boundaries. The former are often civil protection or defence technicians, while the latter involve scientists, engineers, social actors, and institutional and local partners. Preparation is crucial for two main reasons. First, it helps mitigate the impacts and consequences of disasters, thereby reducing the geographical extent and cost of restoration efforts. Second, it involves various activities such as risk assessment, contingency planning, communication planning and training. Restoration aims to restore the capacity of degraded ecosystems to provide ecosystem services, and rebuild essential services and social support for individuals and communities.

Combining preparedness with restoration will be beneficial in terms of:

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[10] PRIMA is an EU programme for research and innovation in the Mediterranean region, see https://prima-med.org/

- helping communities respond more quickly and effectively to disasters based on the principle that a quick response helps reduce damage (World Bank, 2021);
- saving time and money, with consequences limited to goods; and
- planning mitigation tasks and identifying the necessary resources to allow a faster return to normality.

Combining preparedness and restoration efforts is essential for building strong and resilient ecosystems and communities. By doing so, the impact of disasters can be reduced, lives can be saved, financial resources can be better allocated and used, and recovery outcomes can be improved. In the face of new and evolving hazards, it is important that communities, particularly in the Mediterranean region, embrace new technologies and strategies for combining preparedness and restoration efforts, and work together to create safe and resilient societies.

Research, innovation and green skills: the green transition in the Mediterranean based on knowledge

Academia has a clear role to play in shaping the green transition in the Mediterranean. It can empower youth to become actors of change in developing novel solutions and harnessing the knowledge and skills needed locally for change to happen. Research and innovation require cooperation among different societal actors, including government, industry, academia, civil society and even the environment to achieve economic growth and sustainability. In this respect, the Second UfM Ministerial Declaration on Environment and Climate Change, strengthened by the European Green Deal, is setting the region on a path towards climate neutrality and nature restoration while creating new opportunities for jobs and economic growth throughout the Euro-Mediterranean region.

Skills and knowledge are essential to an inclusive green transition and the digital transformation of local economies. Many of the intervention areas needed to make the shift towards sustainable economic growth are research-intensive, requiring innovative technologies, knowledge, collaboration, entrepreneurship, and new training tools and models for re-skilling and upskilling the industries that pollute the most. Forestry, along with other environmental entry points, can link higher education, vocational education and research with local economy needs, by connecting the education and research agendas with the environmental 2030GreenerMed agenda. In this regard, the UfM has long supported the implementation of the Mediterranean Strategy on Education for Sustainable Development, alongside other institutions.

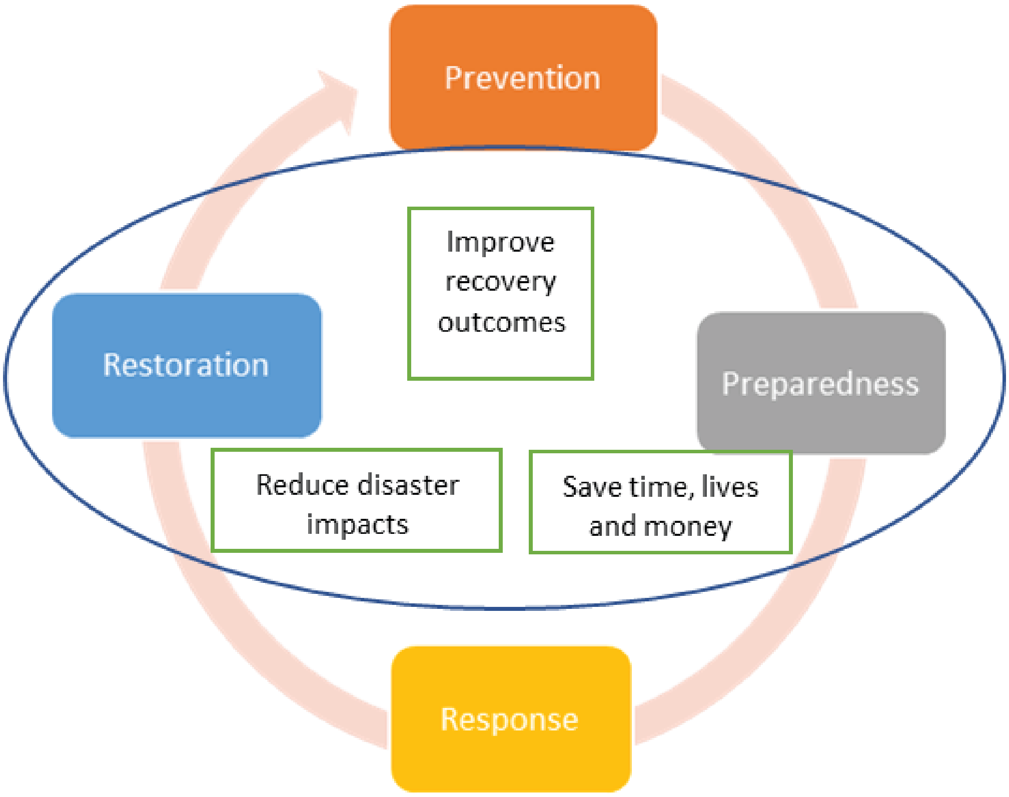
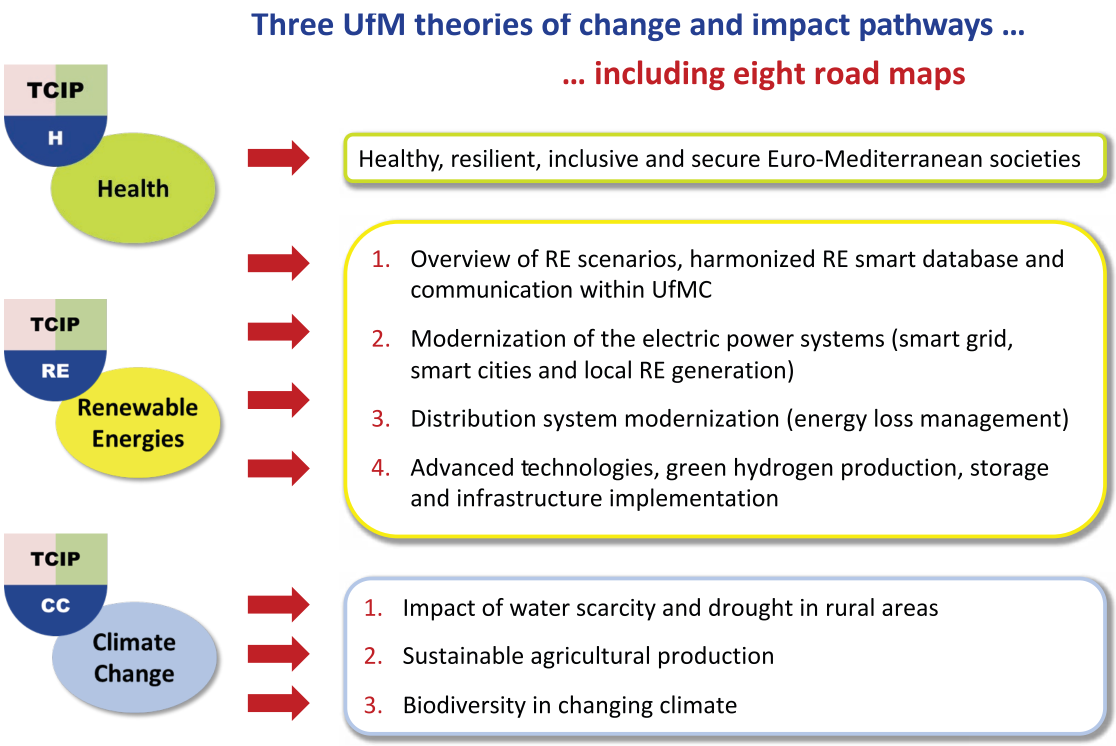


Figure 4. The four phases of the disaster risk management cycle



Three UfM theories of change and impact pathways …

… including eight road maps

Healthy, resilient, inclusive and secure Euro-Mediterranean societies

1. Overview of RE scenarios, harmonized RE smart database and communication within UfMC
2. Modernization of the electric power systems (smart grid, smart cities and local RE generation)
3. Distribution system modernization (energy loss management)
4. Advanced technologies, green hydrogen production, storage and infrastructure implementation

1. Impact of water scarcity and drought in rural areas
2. Sustainable agricultural production
3. Biodiversity in changing climate

Figure 5. UfM theories of change and impact pathways

Providing a policy framework for the entire Euro-Mediterranean region, eight research and innovation agendas were adopted at the UfM Ministerial Conference on Research and Innovation in June 2022, corresponding to three theories of change and impact pathways: climate change, renewable energy and health (see Figure 5). These agendas establish many entry points in which forests can contribute to a more resilient and sustainable Mediterranean region.

In a push towards implementing these agendas, a "Mediterranean Initiative" is being included for the first time ever in the European Union's Horizon Europe 2022–2023 programme. This series of research and innovation calls, open to Mediterranean countries over the biennium, builds on the three UfM pathways and creates momentum for other Mediterranean stakeholders to contribute.

One of the reasons for the high levels of unemployment among Mediterranean youth is the structural gap between the skills acquired at universities and the requirements of businesses. The UfM Handbook for Academia, Industry and Policymakers (Volles and Switzer, 2020) has mapped best practices on innovation and employability in Mediterranean countries. Education and research are among the most impactful policies that can be implemented in the "green shift" to improve human capital, embedding skills, knowledge and an innovative mindset in societies, and preparing for a labour market with increased demand for green jobs.

Academia needs to be prepared and accompany this process by supporting the many industries impacted, such as renewable energy, waste and water management, agrifood and forestry, transport, textiles, and tourism and hospitality. This requires universities and research centres to be better connected to the business sector and create employability paths for youth and women, for example through closer interconnection between vocational education and higher education (Lassadi and Turki, 2022).

There is a need for renewed discussion on how to embed the skills and knowledge needed for sustainability in academic curricula and research initiatives, especially in the fields of agrifood, forestry and renewable energy as starting points.

Youth and women as agents of change in the UfM policy agendas: mainstreaming a transformative approach

In October 2022, the UfM members adopted the Fifth UfM Ministerial Declaration on Strengthening the Role of Women in Society.

Ministers acknowledged that gender equality in the Euro-Mediterranean region had come a long way since 2015 when they established a regional dialogue on women empowerment in the region. However, they also agreed that extra effort was required, especially considering the multiple crises in respect of health, climate change and more recently, emerging needs with regard to food, water and energy security.

The 2021 Progress Report on Gender Equality and the insights gathered during the fourth High-Level Conference on Women for the Mediterranean will contribute to shaping the road map towards gender equality in the UfM countries.

The ministers recognized the role of women in leading the way for climate change adaptation and risk reduction in agrifood systems, in their roles as farmers, livestock keepers, fisher folk, foresters and water users. But women must be included in all measures aimed at fighting water scarcity and climate change. Rural women help build resilient communities and take decisions on resource use and investment in the interest of their communities and families, ensuring food and nutritional security. However, the contribution of women is restricted through persisting gender biases and discrimination. Across the Near East and North Africa region, women have limited access to key agricultural assets, inputs, financing, technologies and services. Only 5 percent of women are landowners, one of the lowest percentages in the world (UN Women, undated).

In order to tackle these key challenges, for the last 2 years, the UfM has been working in close cooperation with key stakeholders like FAO and CIHEAM, focusing on the role of women in agrifood systems and on the Youth Commitment to Sustainable Food Systems.

Young women are among the main target groups of the UfM Youth Strategy 2030 adopted in 2021 and which will be operationalized through an action plan officially adopted in November 2023, back-to-back with the third edition of the Mediterranean Youth Academy.

The youth action plan is the main outcome of the ongoing work of four regional thematic working groups currently involving regional stakeholders and youth-led civil society organizations.

Lastly, a gender mainstreaming agenda was adopted in 2023 to ensure that a gender-based approach permeates all UfM priorities on ensuring sustainable development, including the green and blue economy, water, sustainable food systems, climate finance and disaster risk reduction.

The UfM Water and Youth Engagement Strategy

Through its 5-year water and youth engagement strategy (UfM, 2023), the UfM aims to help young people overcome the barriers that prevent them from building successful careers in the water industry. The strategy has three key objectives:

- attracting prime talent into the water sector;
- strengthening policy skills; and
- building capacity for careers and entrepreneurship in the water sector.

The strategy seeks to ensure that youth is involved in a meaningful and active way. To achieve these objectives, nine key programmes have been designed: Water Jobs Short Feature Films, Seminar Series, Consortium for Water Training, Young Changemakers in Policy, Youth in Policy Dialogues, Youth Seat on the UfM Water Expert Group and Task Forces, Immersion Experience, Internship Experience, and Professional Mentorship. Such programmes, based on surveys of individuals and youth organizations from the Mediterranean, focus on green, inclusive and circular economy approaches to improve the environment, reduce climate impacts and create employment opportunities.

The strategy is cross-cutting with other UfM agendas and thematic areas, including landscape restoration, and embraces a new vision recognizing diverse water career paths beyond the water sector, where everyone has a role to play in addressing the complex water challenges facing the Mediterranean. Furthermore, the strategy contributes to regional development cooperation agendas, such as the Strategy for Sweden's regional development cooperation with the Near East and North Africa 2021–2025, and the European Commission's new Agenda for the Mediterranean under its renewed partnership with the Southern Neighbourhood.

The UfM Water and Youth Engagement Strategy 2023–2028 is a small piece in a larger puzzle reflecting a brighter Mediterranean future for all. To maximize efforts and enhance cooperation, the UfM seeks to ensure that each stakeholder contributes coherently to the joint priorities in the drive to build that brighter future.

Communication and dissemination at the international, regional and national levels: the Mediterranean leads by example

The Euro-Mediterranean region faces numerous challenges, including environmental degradation and climate change. In this context, effective communication and outreach are crucial for promoting sustainable development and mitigating their environmental, social and economic impacts. Institutions like the UfM play a key role in promoting communication and outreach at the national, regional and international levels.

At the **national level**, communication and outreach are necessary to coordinate and align policies and initiatives across countries. The UfM facilitates dialogue and cooperation among member states to develop joint strategies and action plans for sustainable development. This may include sharing best practices, coordinating research and innovation, and advocating for policy changes that promote sustainability. By working together at the national level, countries can achieve greater impact and progress towards their shared sustainability goals.

At the **regional level**, communication and outreach are important to build partnerships and mobilize resources for sustainable development. The UfM engages with regional organizations and stakeholders to promote collaboration and resource sharing on key issues like climate change and environmental degradation. This may include developing regional programmes and projects, securing funding and investment, and fostering partnerships between different sectors and industries. By coordinating efforts at the regional level, the UfM facilitates sustainable development on a larger scale and contributes to a more cohesive and integrated Euro-Mediterranean region.

Finally, at the **international level**, communication and outreach are crucial to promote awareness and action

Raising awareness on the importance of forest and landscape restoration in Lebanon and Morocco

Videos are an important tool for raising awareness on issues because they are effective, shareable, emotional, customizable, and can showcase positive solutions. By using videos to communicate messages in a succinct and engaging way, individuals and organizations can reach a wider audience and inspire positive change on the issues that matter most.

In 2022, a video produced on the FAO-promoted project "Scaling Up Forest and Landscape Restoration" effectively promoted restoration mechanisms in Lebanon and Morocco, and was presented during the Seventh Mediterranean Forest Week in 2022, contributing to knowledge transfer and innovation in Mediterranean forestry informed by national practices.

Check out the full video here

Litter-free is the way to be: reducing plastic pollution in the Mediterranean region

Sharing best practices from a regional marine litter cleaning initiative such as "Plastic Busters" is crucial for building partnerships, securing funding, and expanding the project's reach. By collaborating with other organizations, the project can leverage additional resources and expertise to achieve greater impact, and by promoting its success to potential funders, the project stands a greater chance of securing financial support. Outreach actions are key to leveraging the project's impact and maximizing results to combat marine pollution.

Thanks to continuous and coordinated efforts, the new project "Plastic Busters CAP: Fostering Knowledge Transfer to Tackle Marine Litter in the Mediterranean" kicked off in January 2022 under the umbrella of the UfM-labelled Plastic Busters initiative. This is part of a drive to improve integrated coastal zone management, which is expected to promote better local development planning.

Climate change in the Mediterranean: raising the region's voice on the global stage

For the first time in climate negotiations, the COP27 held on 6–18 November 2022 hosted a Mediterranean Pavilion, seeking to highlight both the urgent challenges faced by the region and the innovative solutions already being developed. The Mediterranean Pavilion is an initiative of the Union for the Mediterranean (UfM) secretariat to create a coalition of like-minded partners headed by the Mediterranean Experts on Climate and Environmental Change (MedECC) network, which includes 600 scientists from the region.

The UfM and its partners had previously coordinated outreach efforts to raise the alarm on the global stage about the findings of the first scientific assessment on climate and environmental change in the region produced by the MedECC network. Disseminated through over 900 media articles, more than 50 key interviews and op-ed pieces published by top media from across the region, and almost half a million views for its dedicated videos, the report's findings are now integrated daily into the stakeholders' narratives on the impacts of climate change in the Mediterranean.

More information on the first Mediterranean Pavilion:

Check out the video on the report's findings here:

on global sustainability challenges. The UfM works with international organizations and partners to promote the region's priorities and interests on issues like climate change, biodiversity and sustainable development. This includes participating in global fora and negotiations, advocating for policy change, and building partnerships and alliances with other regions and stakeholders. Through international engagement, the UfM strengthens the region's voice and influence on global sustainability issues and promotes strengthened cooperation and action towards shared goals.

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Catalysing restoration efforts in the Mediterranean region through the United Nations Decade on Ecosystem Restoration 2021–2030

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The United Nations Decade on Ecosystem Restoration 2021–2030

The United Nations Decade on Ecosystem Restoration 2021–2030 (the "Decade") was declared in 2019 by the United Nations General Assembly to respond to the critical need to prevent, halt and reverse the degradation of all types of ecosystems worldwide in order to meet the Sustainable Development Goals (SDGs). Led by FAO

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The World Restoration Flagship "Restoring Mediterranean Forests" represents a substantial endeavour to address the degradation of forest ecosystems. Since 2017, 2 million hectares have been restored, and 8 million hectares are planned for restoration by 2030, creating 50 000 green jobs in the process

and the United Nations Environment Programme (UNEP), the Decade is an unique opportunity to massively inspire, support and scale up effective ecosystem restoration efforts that maximize benefits for nature and people at the global level, and to contribute to the global goals of the Kunming-Montreal Global Biodiversity Framework of the Convention on Biological Diversity (CBD), the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC), the Land Degradation Neutrality (LDN) targets of the United Nations Convention to Combat Desertification (UNCCD) and the Bonn Challenge. In the context of the Decade, ecosystem restoration is "the process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity. Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice" (UNEP, 2021, p. 7).

The governance structure of the Decade involves a network of more than 200 partners, five Taskforces (on Best Practices, Finance, Monitoring, Science and Youth), an Advisory Board and a Strategy Group that collectively mobilize efforts to support its mission. A strategy that reflects the vision, goals, barriers and pathways of the Decade was launched in 2020 (UNEP and FAO, 2021), followed by an action plan (UNEP and FAO, 2023) structured around 12 themes and 30 challenges for restoration, which will be jointly implemented by Decade partners. Likewise, the Taskforce on Best Practices, established under the leadership of FAO to undertake knowledge-dissemination and capacity-development efforts, has developed principles (FAO, IUCN CEM and SER, 2021) and standards (Nelson *et al.*, 2024) to guide ecosystem restoration with the ultimate goal of assisting practitioners in maximizing the ecological, cultural and socioeconomic benefits of their restoration activities.

Overcoming barriers to restoration in the Mediterranean region

In the Mediterranean region, forest and landscape restoration (FLR) is fundamental for addressing several challenges: land abandonment and lack of management in the north of the region, which increase the risk of wildfires; forest and land degradation in the south and east, mainly caused by overgrazing and overexploitation; and pest outbreaks and droughts as a result of climate change as an aggravating factor in the whole region (FAO and Plan Bleu, 2013, 2018). The critical importance of FLR in the region was underlined in the Antalya Declaration endorsed at the Seventh Mediterranean Forest Week held in Türkiye in 2022 and before that by the endorsement of the Agadir Commitment (FAO, 2017) to restore 8 million hectares (ha) of Mediterranean degraded land by 2030. To undertake and accelerate effective FLR initiatives, multiple limitations need to be addressed with regard to the supportive legislative and policy frameworks; public awareness and political will; and the lack of technical capacities and long-term investment in large-scale restoration and scientific research (UNEP and FAO, 2021). The purpose of this article is to highlight some of the concrete actions that are being developed in the Mediterranean region to help address these challenges, and thus contribute to achieving the mission of the Decade.

Efforts to support knowledge dissemination and capacity development

Sharing knowledge from restoration initiatives is crucial for strengthening the capacities of practitioners and scaling up restoration efforts. This way, errors are less likely to be repeated, and the replication and adaptation of successful experiences are facilitated. In the Mediterranean region, the LIFE Programme (acronym for the French L'Instrument Financier pour l'Environnement), the Decade's Taskforce on Best Practices, MedForVal and Istituto Oikos, as well as the European Forest Institute (EFI), are leading some of the initiatives focused on capacity development and knowledge sharing.

The LIFE Programme was established by the European Union as a funding instrument for environmental and climate action projects. Under the Programme, over 1 100 projects have undertaken forest-related activities. More than 300 projects are intended to improve forest structure and composition, restore or maintain forest habitats, increase their resilience to climate change or their suitability for protected species. When successfully tested, these actions are considered to be good practices. The **LIFE project GoProFor** (LIFE17 GIE/IT/000561 "GOod PRactices implementation netwOrk for FORest biodiversity conservation") has collected the forest-related good practices tested in LIFE projects in a single database. The aim of the database is to capitalize on the LIFE's decades of experience by providing a wide range of easily accessible and detailed good practices to promote their dissemination and replication. To date, over 270 good practices are available, derived from more than 140 projects from 22 European countries. About 120 of them concern forest restoration, 49 of which have been implemented in the Mediterranean region.

In the database, good practices are classified based on macrothemes such as forest biodiversity, habitats, invasive alien species, climate change, planning, management and governance. The database is also used in Italy for training purposes at the national level, representing another vehicle for disseminating good practices. Furthermore, GoProFor is collaborating with the **Decade's Taskforce on Best Practices** to disseminate effective practices through the Framework for Ecosystem Restoration Monitoring (FERM) platform. FERM is the official monitoring platform for tracking global progress and disseminating good practices for the Decade. Among several functionalities, it includes a common search engine that connects good practices on ecosystem restoration documented by collaborating platforms and databases, such as GoProFor, WOCAT, Panorama Solutions, and those collected directly through FERM.

MedForVal, a network of 19 protected Mediterranean forest landscapes, and the Italy-based secretariat of **Istituto Oikos** have been working intensively on disseminating good practices for ecosystem restoration in the region. In 2021, the results of a survey on FLR in the Mediterranean were published as part of the project "Mediterranean Knowledge on Forest Landscape Restoration" funded by the MAVA Foundation. The document included eight case studies from five countries (Greece, Italy, Morocco, Spain and Türkiye) collected through a questionnaire circulated among Mediterranean networks and mailing lists. Featured good practices include a wide range of restoration targets, including mosaic landscapes in Spain, ecological corridors in Italy, silvopastoral ecosystems in Morocco, river watersheds in Türkiye and priority Natura 2000 habitats in Greece.

Currently, two projects are being implemented by MedForVal partners and Istituto Oikos explicitly addressing the transboundary dissemination of good practices. The first project, "From the Apennines to the Shouf – AsMED", funded by the Italian Agency for Development Cooperation, aims to foster exchanges between Italy (Aterno Valley) and Lebanon (Shouf Biosphere Reserve) on good practices for landscape restoration and management, addressing forest, agricultural and water management. The project activities include training courses, field visits, remote technical assistance and workshops, with the expected outcome of promoting knowledge sharing to encourage the use of participatory management tools and mechanisms based on proven models. The second project, "MediterRE3", funded by the German Cooperation (EUKI), was implemented in the Luberon-Lure Biosphere Reserve, France, Prokletije National Park, Montenegro, and Samarià National Park, Greece. It aims to promote fire-smart resilient landscapes through mosaic landscape restoration in the region. Its results and selected good practices were summarized in a document published in 2023.

Under the leadership of EFI and in coordination with Wageningen Environmental Research, a network of 36 partners from 16 countries was created to develop the project SUPERB. The project will link practical and scientific knowledge to enable effective FLR action on the ground in 12 large-scale demonstration areas across Europe. The project has six objectives, one of them being to deliver a multilingual Forest Ecosystem Restoration Gateway to obtain evidence-based guidance on forest restoration, including restoration-support tools, manuals and guidelines. The SUPERB project and the Decade's Taskforce on Best Practices are also collaborating to promote synergies in the context of the Capacity, Knowledge and Learning Action Plan developed by the Taskforce (Taskforce on Best Practices for the United Nations Decade on Ecosystem Restoration, 2023).

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Group of women working on a plant nursery in Lebanon producing indigenous species to support restoration activities

Efforts to create and reform supportive legal and policy frameworks

In 2010, the Collaborative Partnership on Mediterranean Forests (CPMF) was created to enhance adaptation and implementation of policies and strategies for sustainable management of forests and their ecosystem services to improve the response to climate change. In particular, the CPMF aimed to strengthen capacities for forest management, intersectoral cooperation, communication, dissemination of knowledge and information, awareness-raising, and mobilization of external support and partnerships (FAO, 2012). Likewise, in 2013, the Strategic Framework on Mediterranean Forests (SFMF) and the Tlemcen Declaration[11] were adopted and endorsed by Mediterranean countries at a High-Level Segment of the Third Mediterranean Forest Week in Tlemcen, Algeria, in March 2023. The SFMF was established to provide policy orientations for integrated management of forest ecosystems in Mediterranean landscapes. It is structured around three objectives and nine strategic areas, one of which is focused on restoring degraded Mediterranean forest landscapes. In addition, the Agadir Commitment, endorsed in 2017 by nine Mediterranean countries and supported by multiple international organizations, established the Mediterranean Regional Initiative with the aim of restoring 8 million ha of degraded land by 2030, and supporting the achievement of the Bonn Challenge, the SDGs, the United Nations Forum on Forests (UNFF) and the Rio Conventions (FAO, 2017). Afterwards, the Brummana Declaration[12] was adopted as a framework to discuss the role of Mediterranean forests in fulfilling the nationally determined contributions (NDCs) under the Paris Agreement. More recently, in 2022, the European Commission proposed the Nature Restoration Law as a core element of the EU Biodiversity Strategy, which was adopted by the European Council in June 2024. This sets binding restoration targets that contribute to restoring at least 20 percent of the European Union's land and marine areas by 2030, and all ecosystems by 2050.

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[11] On 21 March 2013, the Mediterranean countries endorsed the Tlemcen Declaration as a call for increased focus on the sustainable development of Mediterranean landscapes.

[12] On 4 April 2019, the Mediterranean countries endorsed the Brummana Declaration at the High-Level Segment of the Sixth Mediterranean Forest Week held in Brummana, Lebanon.

Box 1. Efforts towards ecosystem restoration in Lebanon

National political instruments: In 2015, the Ministry of Agriculture (MoA) in Lebanon launched its first **National Forest Programme (NFP)** as the main instrument of its national forest policy for 2015–2025. The programme aims to manage Lebanon's forest resources sustainably and includes the restoration of degraded forest land. In addition, the **National Afforestation and Reforestation Plan (NARP)** was launched in 2012, also known as the Road Map for 40 Million Trees. Through this programme, the MoA aims to restore and increase forest land and tree cover from 13 percent of Lebanon's total land area to 20 percent over 20 years, by promoting public–private partnerships. Several multilateral and bilateral donors supported the programme, and more than ten country-level projects were developed to meet its objectives. Importantly, Lebanon was one of the seven countries initially selected by the FAO Forest and Landscape Restoration Mechanism (FLRM) to implement restoration activities. The revision of the **Lebanese Forest Law** to include rangeland management as an important component of FLR is currently ongoing, with the development of several rangeland restoration plans at the municipal level and the publication of guidelines on rangeland management at the national level.

Restoration target by 2030: The NARP aims to increase forest cover from 13 percent today to 20 percent of the country's land area, that is, 70 000 hectares (ha).

Progress to date: Under the NFP, more than 15 000 ha of land have been restored through different activities such as reforestation, post-fire rehabilitation, excavation site rehabilitation and forest connectivity corridors. With the support of FAO, the International Climate Initiative (IKI), the International Fund for Agricultural Development (IFAD), the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP), and in close collaboration with local non-governmental organizations, land management plans and rangeland restoration activities have recently been completed on more than 50 000 ha of highly eroded highlands and plain rangelands.

Box 2. Efforts towards ecosystem restoration in Morocco

National political instruments: Historically, the Government of Morocco has developed and implemented several strategies, plans and programmes to tackle the root causes of land degradation and promote restoration, such as the National Plan for Watershed Management (1996–2016), the previous National Forest Programme launched in 1999, and the National Strategy for Sustainable Development 2015–2020. More recently, the **new forestry strategy "Forests of Morocco 2020–2030"**, focuses on restoring degraded forest land by involving local communities in the sustainable development of forests, using suitable incentives and planning.

The **National Sustainable Development Strategy 2017–2030** highlights the need to reduce land degradation and promote the sustainable management of natural resources, including restoration. In 2021, Morocco submitted its revised nationally determined contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat to better integrate FLR in the forest sector.

Restoration target by 2030: The forestry strategy "Forests of Morocco 2020–2030" has set a reforestation goal of 500 000 hectares (ha) of forest plantations by 2030, in the 12 regions of the country at a rate of 50 000 ha per year.

Progress to date: The restoration of silvopastoral ecosystems in Morocco is a long-term, nationwide programme which has been running since 2005 to restore forests and silvopastoral ecosystems while improving livelihoods. Around 120 000 ha of forest were restored between 2005 and 2018, involving 180 associations representing about 20 000 users and mobilizing MAD 25 million per year (over EUR 2.3 million) in compensation from the government for foregone pasture.

The "Management and Protection of the Mountain Forests of the Ifrane Province" project started in 2002 and lasted 6 years. It focused on 163 000 ha within and around the Ifrane National Park in the Middle Atlas. A co-management approach with protection and compensation – called "social silviculture" – has been implemented since 2002 and is showing results. In addition, since the endorsement of the Agadir Commitment in 2017 and in line with national strategies, Morocco has restored around 113 000 ha of degraded land through afforestation and reforestation.

Box 3. Efforts towards ecosystem restoration in Tunisia

National political instruments: The Tunisian Government established the **National Strategy for the Development and Sustainable Management of Forests and Rangelands 2015–2024**, with the aim of supporting the forest and pastoral sectors, and ensuring sustainable local development in a way that generates employment and income for the 800 000 people residing in these ecosystems.[i] Among the steps to implement this strategy, a 2016–2020 development plan focusing on the forest and pastoral sectors was prepared. In 2020, the General Directorate of Forests of Tunisia initiated the "**Forest, Pastoral and Olive Inventory (IFPON)**" to gather updated and reliable data and statistics on forest and pastoral resources, as part of a project agreed between the Tunisian Government and the World Bank. In addition, the General Directorate of Forests developed an action plan to establish a suitable forest governance framework for restoring forests and landscapes and achieving Land Degradation Neutrality (LDN). This plan includes revising the legal framework and institutional set-up related to forest resources and implementing a programme to clarify land tenure.

Restoration target by 2030: In its National Biodiversity Strategy and Action Plan (NBSAP) 2018–2030, Tunisia has committed to conserve and restore 2 000 000 hectares (ha) of land by 2030.[ii]

Progress to date: Tree-planting initiatives are considered among the main restoration activities of forest and pastoral ecosystems in Tunisia. From 2017 to 2021, Tunisia planted 13 200 ha with forest species in burnt, degraded and exploited forests, and 18 590 ha with pastoral tree and shrub species for the conservation of rangelands, the improvement of fodder production and the restoration of degraded ecosystems.

Sources:

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From commitments to action on the ground

Before the declaration of the Decade, several initiatives were already ongoing to foster FLR in the Mediterranean region and to contribute to the implementation of the Agadir Commitment. For example, the "Paris Agreement in Action" project funded by the International Climate Initiative (IKI) of the German Federal Ministry for Economic Affairs and Climate Action supported several countries, including Lebanon and Morocco representing the Mediterranean region, to upscale FLR initiatives as a strategy for achieving their NDCs.

Since the declaration of the Decade, the focus has been on encouraging countries to continue moving from commitments to effective action on the ground. To that end, the Decade has set up regular calls for nominations of World Restoration Flagships, which are considered the "first, best or most promising examples of ecosystem restoration, adding value and embodying the ten restoration principles, while inspiring others to undertake or accelerate restoration at significant scale" (UNEP and FAO, 2023). The first call was launched from January to March 2022, receiving 154 expressions of interest and 73 government-endorsed nominations. After an assessment process led by the Taskforces on Best Practices and Science, 17 flagships with the best scores were selected and launched in 2022–2024, covering a broad representation of ecosystems and regions. In addition, a Multi-Partner Trust Fund was established in 2021 by FAO and UNEP with the ambition to raise at least USD 100 million by 2030 to support the implementation of the Decade's strategy and flagships. For this first call, the Committee on Mediterranean Forestry Questions – *Silva Mediterranea*, on behalf of eight partner organizations, nominated and submitted the flagship "Restoring Mediterranean Forests," which was one of the World Restoration Flagships selected and announced in 2024.

The Mediterranean flagship includes activities that target the Mediterranean region as a whole, with a specific focus on Lebanon, Morocco, Tunisia and Türkiye, which are part of the group of countries that endorsed the Agadir Commitment in 2017. The Mediterranean flagship focuses on scaling up mosaic FLR in the four selected countries of the Mediterranean region, thereby contributing to the implementation of the Decade in line with regional and national commitments. The flagship has been created using a regional development model based on the sustainable use of land and the conservation of natural resources, to address the degradation associated with inappropriate use and climate change impacts. Boxes 1–4 provide an overview of the progress achieved by each of the four countries in terms of

Box 4. Efforts towards ecosystem restoration in Türkiye

National political instruments: The general policy in Türkiye is defined by the Ministry of Development through the National Development Plan. The main policy documents are the Twelfth Development Plan (2024–2028)[i] and the General Directorate of Forestry's Strategic Plan (2024–2028).[ii] Moreover, the most relevant forest-related laws and programmes adopted by the Turkish Government are as follows:

- The **Law on Environment** (1983) and the Law on National Parks (1983) are complementary documents that support the intended nationally determined contributions for the forest sector.
- The **Law on National Afforestation and Erosion Control** (1995) aims to increase the forest area and tree wealth, establish and improve the balance between soil, water and plants, protect environmental values, and regulate the principles and procedures of afforestation and erosion control work.
- The **Turkish National Forestry Programme** (2004–2023) promotes and supports the sustainable development, expansion and management of forests as key priority objectives for Türkiye and represents a sound legal basis for sustainable forest management, including by ensuring the development of institutional capacities.
- Türkiye has been a supporting partner in forest protection, restoration and deforestation-free supply chains with a running budget of USD 10 billion and has carried out five projects with FAO's Subregional Office for Central Asia as an implementing agency.
- In line with the government's ambitious vision for development, in 2019, Türkiye boosted forestation efforts, starting an initiative called "Breath for the Future" as the country strives to expand its forests by planting millions of saplings across the country in collaboration with national stakeholders and other partner countries. Large-scale tree planting, restoration of degraded and deforested lands, and pasture improvement are key measures to combat erosion and desertification in Türkiye, that are being implemented as part of an action plan led by the government.

Restoration target by 2030: Türkiye has committed to restore 2 300 000 hectares (ha) by 2030 as part of the Bonn Challenge, and increase its forest area to 30 percent by 2030 through afforestation, erosion control and rehabilitation activities.

Progress to date: The forest area in Türkiye has increased since 1973, with the initial forest inventory showing a forest cover area of 20.2 million ha (26.1 percent of the total area), increasing to 23.3 million ha (around 30 percent of the total area) in 2023 as shown by the 2023 annual activity report.[iii] The forest cover in Türkiye is expected to reach 30.3 percent by 2028, based on the targets in the General Directorate of Forestry's Strategic Plan 2024–2028.** Out of the 2.3 million ha that were pledged to be restored by 2030, 2.1 million ha were restored in 2010–2022, and the remaining 200 000 ha are expected to be completed by 2030.

Notes:

[i] Türkiye. 12th Development Plan 2024–2028, 2023. Also available at: https://onikinciplan.sbb.gov.tr/wp-content/uploads/2023/11/On-Ikinci-Kalkinma-Plani_2024-2028.pdf

[ii] GDF (General Directorate of Forestry). 2023. General Directorate of Forestry Strategic Plan 2024–2028. https://www.ogm.gov.tr/tr/e-kutuphane-sitesi/StratejikPlan/Orman%20Genel%20M%C3%BCd%C3%BCrl%C3%BC%C4%9F%C3%BC%20Stratejik%20Plan%20(2024-2028).pdf

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developing and implementing conducive policy instruments, and fulfilling their respective restoration commitments by the end of the Decade.

Scaling up restoration efforts in the region

One of the main impacts of climate change in the region is the increased frequency, intensity and duration of wildfires (FAO and Plan Bleu, 2013, 2018). Improving capacities is key to restoring the ecological integrity of burnt areas and making them more fire resistant and resilient to future wildfire events. A wealth of knowledge and good practices are already being generated within the region, which should be systematically documented and shared to allow for replication and scaling-up. Support targeted at the Mediterranean flagship is specifically focused on capitalization and knowledge-sharing efforts with regard to post-fire restoration in the Mediterranean region as described in Box 5.

Box 5. Targeted support to capitalize and share knowledge on post-fire restoration in the Mediterranean region

The objective of the targeted support will be to capitalize on current post-fire restoration efforts in the region in order to promote knowledge sharing among regional actors, which will also contribute directly to the Agadir Commitment and to the *Silva Mediterranea* Strategy 2019–2030, "Integrate fire prevention in national forest programmes and adaptation strategies to climate change," including post-fire restoration as part of the fire management cycle.

Building on the work being done by the Taskforce on Best Practices of the United Nations Decade on Ecosystem Restoration (the "Decade"), documentation and dissemination of good practices through the Framework on Ecosystem Restoration Monitoring (FERM) platform will be undertaken for post-fire restoration in the Mediterranean. This will provide a knowledge-sharing and learning opportunity for all stakeholders dealing with wildfire management in the region. The activities proposed will allow for scaling up effective restoration efforts by showcasing all good practices of post-fire restoration being used in the region that could be replicated in different areas, and will provide regional momentum for collaboration on post-fire restoration.

The targeted support will strengthen the political will to invest in a joint regional effort to restore more resilient landscapes prone to wildfires, thus contributing to the implementation of the regional flagship. There is already a strong commitment in the region among country members of the Committee on Mediterranean Forestry Questions – *Silva Mediterranea*. The role of Decade partners such as the Centre for Mediterranean Cooperation of the International Union for Conservation of Nature (IUCN), the Society for Ecological Restoration (SER), the Lebanon Reforestation Initiative, among others, will be fundamental in supporting post-fire restoration efforts. The targeted support will involve working with national counterparts and local communities on collecting good practices, involving all relevant stakeholders, including youth and women, in the knowledge-generation and learning process.

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Perspectives at the end of the flagship

The four target countries of the flagship are inspiring examples of strong political will, commitment and tangible results on the ground at the national level, showing strong potential for learning, replicability and scalability and for global and regional outreach. The recognition of the Mediterranean flagship as one of the World Restoration Flagships of the Decade, will allow to strategically expand its activities by attracting global attention and investments, creating supportive legal frameworks and incentives, triggering policy dialogue, joint advocacy, knowledge sharing and replication of good practices within the region, and sharing lessons learned to the global community, thereby showcasing the potential of FLR. The scaling-up of the restoration activities in each of the four countries in line with the ten principles of the Decade will maximize the ecological and socioeconomic benefits of the flagship, enabling the achievement of the pledges made under the Agadir Commitment and other global goals by 2030.

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Lebanon

The status of restoration in the Mediterranean region

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Introduction

The global context

Land use and management have a significant effect on ecological functions, climate regulation and the provisioning of ecosystem services. Although central to our well-being, land continues to be degraded, with many processes accelerated by human activity. On average, 20 percent of global land is degraded to some extent (UNCCD, 2022). For this reason, land degradation has been identified by the United Nations Convention to Combat Desertification (UNCCD) as one of the most challenging environmental issues, and the importance of restoration and improved land management as means to achieve global sustainability objectives has gained significant attention in recent years.

Building on the momentum of several initiatives, including the Bonn Challenge (2011), and the urgent need to scale restoration efforts, the United Nations declared the decade 2021 to 2030 the United Nations Decade on Ecosystem Restoration (the "Decade"). The Decade is jointly led by the United Nations Environment Programme (UNEP) and FAO, supported by collaborating agencies, and other international initiatives and regional partners, including the International Union for Conservation of Nature (IUCN). Enhancing the three Rio Conventions, the overarching aim of the Decade is to prevent, halt and reverse the degradation of ecosystems on every continent and ocean (see article by Romero Montoya *et al.* on p. 30).

The Mediterranean context

Ecosystems of the Mediterranean region (Photo 1) have been profoundly shaped by human activities since ancient times, resulting in a complex socioecological balance, which is resulting today in degradation processes and affecting the level of biodiversity and ecosystem services provided. The effects of these interactions have increased considerably because of climate change.

Climate change is emerging as the primary driver of environmental change in the Mediterranean region. The region has been identified as one of the most reactive to climate change and identified as a major "hotspot" based on the results of global climate change projections (MedECC, 2020). The latest report of the IPCC (Ali *et al.*, 2022) identifies the Mediterranean as one of the regions that is most vulnerable to the impacts of global warming. Based on estimates, at least 16 percent of Mediterranean forest, animal and plant species are at risk of extinction due to global threats like climate change. Forests in Spain, Italy, Greece,

Photo 1. A typical example of an open Mediterranean oak forest, Yarmouk Forest Reserve, Jordan

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Photo 2. Restoration at the cedar reserve mountain in Barouk, Lebanon

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Türkiye and Morocco have the highest proportions of threatened species, estimated at respectively 26 percent, 24 percent, 21 percent, 17 percent and 15 percent (FAO and Plan Bleu, 2018).

There are 80 million hectares (ha) of degraded land – including forests – in the Mediterranean region. Based on the most recent State of Mediterranean Forests (FAO and Plan Bleu, 2018), the forest area was estimated at 88 million ha in Mediterranean countries in 2015, with an increase of 1.8 million ha between 2010 and 2015. The increase in forest cover has two main causes: the European Common Agricultural Policy and natural forest regeneration in rural areas following land abandonment, which is occurring in several Mediterranean countries.

However, since statistics are provided at the country level and not by biogeographical region, this growth in forest cover includes areas outside the biogeographic Mediterranean region, such as northern Atlantic regions. In contrast with country-level forest statistics, remote sensing studies focusing on the Mediterranean region show that, between 2010 and 2015, forest area in the Mediterranean region remained stable (FAO and Plan Bleu, 2018).

Within this context, Mediterranean forests make crucial contributions to rural development, poverty alleviation, food security, and the water, tourism and energy sectors. However, their rich diversity and variability are threatened by increasing human pressure and accelerated climate change, leading to habitat fragmentation and biodiversity loss, and forest and land degradation and desertification, which are putting human health and livelihoods at risk (Ali *et al.*, 2022).

The Agadir Commitment

In 2017, during the Fifth Mediterranean Forest Week held in Agadir, Morocco, Mediterranean countries pledged, through the Agadir Commitment, to have 8 million ha of degraded land under restoration by 2030 (Photo 2). In preparing to meet this commitment, restoration opportunities in the Mediterranean have been assessed to draw attention to the need for restoration in the region and to roughly estimate the magnitude of restoration opportunities: there are 80 million ha of land with restoration potential, representing 40.2 percent of the Mediterranean as defined by FAO's Global Ecological Zones classification system.

The Agadir Commitment was endorsed by nine countries, namely Algeria, France, the Islamic Republic of Iran, Lebanon, Morocco, Portugal, Spain, Tunisia and Türkiye, to improve forest and landscape restoration (FLR), Land Degradation Neutrality (LDN) and biodiversity conservation efforts in the Mediterranean region. It is supported by several international organizations: the Secretariat of the Convention on Biological Diversity (CBD), FAO, IUCN, the World Resources Institute (WRI), the Global Partnership on Forest and Landscape Restoration (GPFLR), the World Bank, the Global Mechanism of the UNCCD, the Union for the Mediterranean (UfM), Plan Bleu of the UNEP Mediterranean Action Plan (MAP), the European Forest Institute's Mediterranean Facility (EFIMED), the Mediterranean Model Forest Network (MMFN), and the Forest Science and Technology Centre of Catalonia (CTFC).

The Agadir Commitment proposed to establish a new Regional Mediterranean Initiative on FLR to support the achievement of the Bonn Challenge and Sustainable Development Goal 15 (SDG 15). This initiative encourages political and administrative authorities at the national level, as well as stakeholders involved in the management of Mediterranean forest ecosystems and other wooded lands, to strengthen their respective FLR efforts in the context of the United Nations Strategic Plan for Forests 2017–2030 of the United Nations Forum for Forests (UNFF). Furthermore, the initiative is in line with the global FLR objectives of the Rio Conventions and the 2030 Agenda for Sustainable Development.

The Agadir Commitment is focused on four main components:

- assessing the ongoing national efforts on FLR;
- reinforcing regional cooperation on FLR and LDN;
- cooperating with interested partners to develop a consensual, diversified strategy for the financing of FLR efforts and to reinforce national capacities; and
- assessing the respective efforts of countries through the establishment of a voluntary monitoring and reporting system for FLR and LDN efforts in the Mediterranean context.

Implementation and progress of the Agadir Commitment 5 years after its adoption

At the twenty-fourth session of the Committee on Mediterranean Forestry Question – *Silva Mediterranea* ("*Silva Mediterranea*") held in Antalya, Türkiye, in 2022, the committee agreed to prepare an intermediate assessment of the status of the Agadir Commitment 5 years after its endorsement.

A survey using multiple data searching criteria was carried out. The main sources used for data collection were:

- the expertise of *Silva Mediterranea* national focal points and experts in the region, who provided support for data collection, or validated data collected on projects being implemented in the Mediterranean region, with restoration activities conducted from 2017 to 2022 (Table 1); and
- published papers, articles and reports on areas under reforestation in Mediterranean countries from 2017 to 2022.

Regarding the information derived from the literature, the database published by Roe *et al.* (2021), based on Austin *et al.* (2020), was used to report data (ha/year) on areas under afforestation and forest restoration for the period of interest, 2017–2022.

Results

Data provided by six countries, namely Algeria, Morocco, Portugal, Spain, Tunisia and Türkiye, through their respective focal points showed that about 850 000 ha were put under restoration between 2017 and 2022

Table 1. Area restored per country since 2017 based on estimates provided by *Silva Mediterranea* focal points and regional experts

Country	Government entity	Area restored after 2017 (ha)	Specific activity
Algeria	Ministère de l'Agriculture et du Développement Rural, Direction générale des forêts	52 650 (out of 79 946)	Reforestation and forest enrichment; development of arboriculture in mountainous areas; development of watersheds upstream of dams and addressing land degradation in steppe and Saharan areas; restoration of burnt forests and orchards.
Morocco		113 184 (from 2017 to 2021)	New plantations established with seeds and trees produced in nurseries.
Portugal	Portuguese Forest Service: Instituto da Conservação da Natureza e das Florestas (ICNF)	56 439 (from 2017 to 2020)	Reforestation, afforestation with eucalypts, cork oak, pines and chestnut.
Spain	Ministerio para la Transición Ecológica y el Reto Demográfico, Subdirección General de Política Forestal y Lucha contra la Desertificación, Dirección General de Biodiversidad, Bosques y Desertificación	62 566	
Tunisia	Ministère de l'Agriculture, des Ressources hydrauliques et de la Pêche maritime	31 790 (from 2017 to 2021)	Post-fire reforestation, recovery of degraded forests after grazing, improving productivity of agrosilvopastoral systems.
Türkiye	General Directorate of Forestry (OGM)	533 000 (end 2021)	Post-fire restoration, artificial and silvicultural rehabilitation.

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(Table 2: a; Figure 1). For three countries, namely France, the Islamic Republic of Iran and Lebanon, national data were not available.

Based on the database by Roe *et al*. (2021), the total area under restoration of the nine countries that endorsed the Agadir Commitment has been estimated at approximately 4.4 million ha (Table 2: c + d). The 24 countries around the Mediterranean basin accounted for about 6.2 million ha of restored land (not shown).

According to Roe *et al*. (2021), the three countries, namely France, the Islamic Republic of Iran and Lebanon, for which data from the focal points were not available, restored about 1.5 million ha between 2017 and 2022 (Table 2: d). The area under restoration estimated from the national sources (Table 2: a) represents only 29 percent of the area reported in the database by Roe *et al*. (2021) (Table 2: c). Assuming the same ratio for the three countries for which data are currently unavailable, we estimated a global area of approximately 418 000 ha for France, the Islamic Republic of Iran and Lebanon (Table 2: b).

The most conservative estimated area under restoration in the nine countries that endorsed the Agadir Commitment is thus in the range of 1.3–2.3 million ha (Table 2).

Final considerations

From the preliminary survey results, an area of 1.3–2.3 million ha was under restoration in the Mediterranean region between 2017 and 2022. This total is derived from data that are sometimes unofficially provided and have not always been validated by the countries. It should therefore be noted that the data cannot be considered official. Nevertheless, despite this data uncertainty, the estimated restored area gives an encouraging picture of the status of the implementation of the Agadir Commitment and represents a first assessment for discussion and improvement.

This assessment is not comprehensive and does not include all the restoration initiatives carried out in each of the countries concerned. The data in Table 1 and Table 2 refer to restoration efforts mainly in forest areas but also include other types of ecosystems. Also, some of the data available in the database by Roe *et al.* (2021) probably concerns other regions besides the Mediterranean. For some countries, as is the case for France, the Mediterranean biogeographic area is limited to the southern part of the country, which results in an inflated area under restoration, given that it is impossible to extrapolate data to a specific area of interest.

To avoid these types of bias, a monitoring tool for a finer assessment of the Agadir Commitment and restoration in general is needed. This would support the evaluation of past and ongoing interventions, highlight the gaps and help plan future operations. A monitoring tool should urgently be agreed upon and established by the Mediterranean countries so that a valid assessment of the Agadir Commitment can be carried out that includes the types of ecosystems restored.

Table 2. Restored area per country for 2017–2022 based on national data

	Estimated restored area (ha) in 2017–2022	
	from national data*	from Roe *et al.* (2021) **
Algeria	52 650	292 117
Morocco	113 184	327 921
Portugal	56 439	159 105
Spain	62 566	1 036 702
Tunisia	31 790	85 107
Türkiye	533 000	1 068 132
	(a) 849 629	(c) 2 969 084
France	n.a.	1 330 200
Iran (Islamic Republic of)	n.a.	129 960
Lebanon	n.a.	1 870
	(b) 418 372***	(d) 1 462 029
	a + b = 1 268 001	c + d = 4 431 114
	a + d = 2 311 658	

Source: Roe, S., Streck, C., Beach, R., Busch, J., Chapman, M., Daioglou, V., Deppermann, A. et al. 2021. Land-based measures to mitigate climate change: Potential and feasibility by country. Global Change Biology, 27(23): 6025–6058. https://doi.org/10.1111/gcb.15873

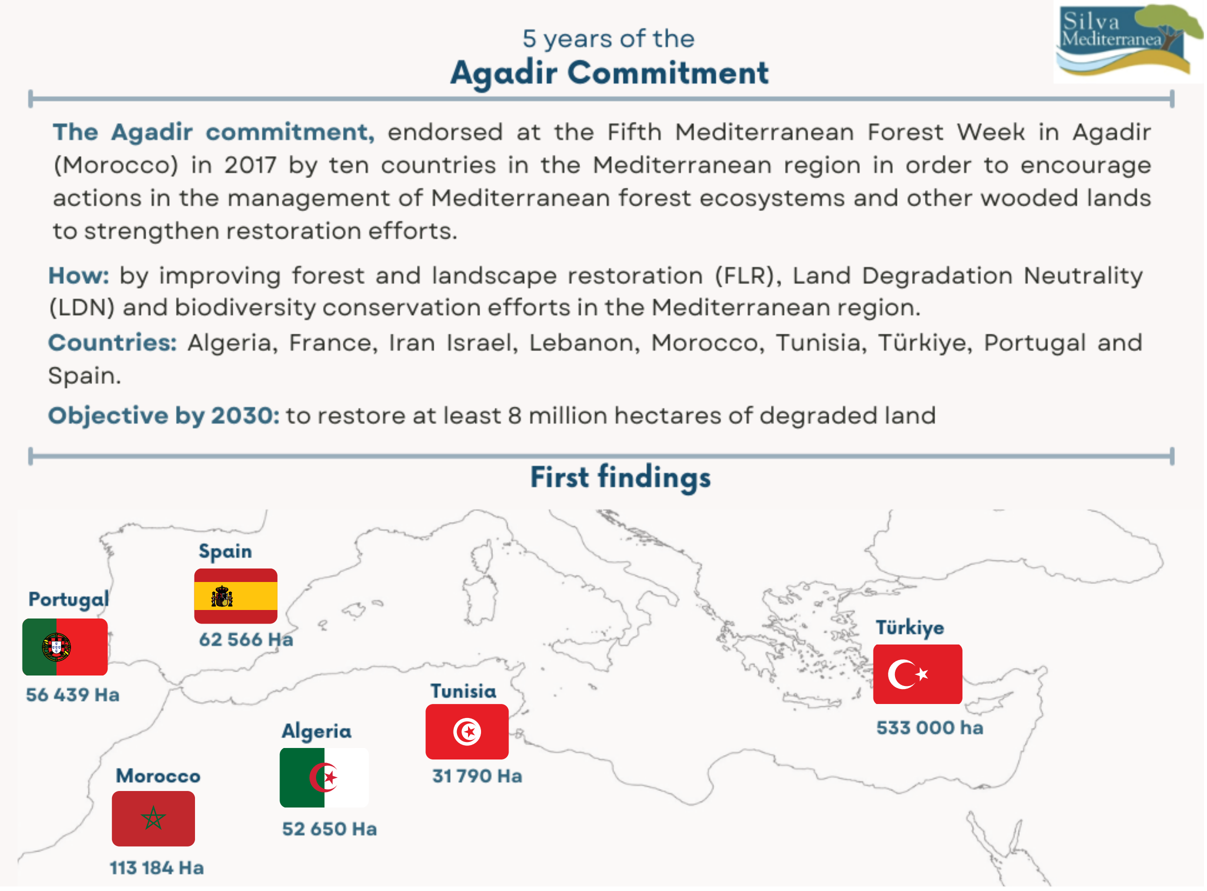
Notes: n.a.: not available.

* Estimates provided by national focal points.

** We refined and updated the mitigation potential of 20 land-based measures in more than 200 countries and five regions, comparing "bottom-up" sectoral estimates with integrated assessment models: Roe, S., Streck, C., Beach, R., Busch, J., Chapman, M., Daioglou, V., Deppermann, A. *et al.* 2021. Land-based measures to mitigate climate change: Potential and feasibility by country. *Global Change Biology*, 27(23): 6025-6058. https://doi.org/10.1111/gcb.1587

*** Estimated as 29 percent of 1 462 029.

Figure 1. The Agadir Commitment after 5 years



5 years of the
Agadir Commitment

The Agadir commitment, endorsed at the Fifth Mediterranean Forest Week in Agadir (Morocco) in 2017 by ten countries in the Mediterranean region in order to encourage actions in the management of Mediterranean forest ecosystems and other wooded lands to strengthen restoration efforts.

How: by improving forest and landscape restoration (FLR), Land Degradation Neutrality (LDN) and biodiversity conservation efforts in the Mediterranean region.

Countries: Algeria, France, Iran Israel, Lebanon, Morocco, Tunisia, Türkiye, Portugal and Spain.

Objective by 2030: to restore at least 8 million hectares of degraded land

First findings

Box 1 Forest mapping and monitoring

Forest maps are an essential tool for forest management. They provide a spatial and temporal context for forest variation and for potential nature-based solutions for restoration. Despite this important need, the existing sources of forest cartography present several limitations. Generally, both the definition of forests and the scale are too broad (broad classes of forest cover, or distinction based only on coniferous, deciduous and mixed forests). In addition, the map accuracy may be too low depending on the methodology used and the availability of field-truthing data.

In the Mediterranean context, forests are very diverse in terms of tree species, forest type and tree density. Compared to temperate and boreal forests, there are more broadleaf trees and mixed stands, and often lower densities, and Mediterranean forests are highly affected by human activity and climate change. The mapping of Mediterranean forest types, based on dominant species, with a high temporal and spatial resolution and high map accuracy, is therefore needed to support forest management at the local scale. On a regional scale, the mapping of Mediterranean forests can support conservation and restoration policies, such as the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), the European Green Deal, the Sustainable Development Goals (SDGs) and the EU Forest and Biodiversity Strategies for 2030.

Using open-source Earth observation big data and artificial intelligence for massive data storage and analysis, forest maps for the entire Mediterranean region at a resolution of a few metres were produced on a yearly basis. National forest inventories from Spain, Tunisia and Lebanon, and databases from the European Vegetation Archive (EVA) were used. The maps were based on Sentinel-2 multispectral imagery, the NASA and JAXA ASTER Digital Elevation Model and derived thematic layers. More than 80 000 forest samples were gathered and curated to feed the models, including approximately 100 tree species in 30 forest classes. Spectral separability analysis was used to confirm the suitability of the ecological descriptions of forest types used in the remote sensing classification.

The study showed the potential benefits of creating standards at the European and regional level for national forest inventories for use in remote sensing applications. Feeding the models with unharmonized forest data was the major bottleneck to achieving good map accuracy, as such data come in different formats, represent different variables and describe different forest type definitions.

Box 2 The Mediterranean World Restoration Flagship of the United Nations Decade on Ecosystem Restoration

In March 2022, the Committee on Mediterranean Forestry Questions – *Silva Mediterranea* applied for the Mediterranean region to be recognized as a World Restoration Flagship under the United Nations Decade on Ecosystem Restoration (the "Decade"), on account of the restoration progress that has been achieved in the geographic area. The region was invested with the flagship status. The Mediterranean flagship focuses on collecting effective post-fire restoration practices established in the Mediterranean region.

Building on the work being carried out by the Decade's Taskforce on Best Practices, documentation and dissemination of good practices through the Framework for Ecosystem Restoration Monitoring (FERM) platform will be undertaken for post-fire restoration in the Mediterranean. The collection of effective good practices in post-fire restoration in the Mediterranean region in the context of the Mediterranean flagship initiative represents a valid tool to begin establishing a sound monitoring system in the region. Additionally, the flagship provides a knowledge-sharing and learning opportunity for all stakeholders dealing with wildfire management in the region. It will also contribute to acquiring the political will necessary to redouble joint restoration efforts across the region and increase the resilience of more landscapes vulnerable to wildfire risk.

This preliminary study advocates for setting up an advanced monitoring system that can support our understanding of the status of degradation and a clear mapping of restoration stakeholders and initiatives. This would help identify priority areas to focus conservation efforts through rewilding and restoration, and enable planning for more targeted actions that are both inclusive and impactful.

There is a need for a more coordinated approach in forest data collection and processing methodologies to be shared across countries as well as among researchers and public bodies responsible for national reporting to the European Union and to meet international obligations. *In situ* traditional monitoring practices combined with new technologies, such as satellite and remote sensing data integrated with artificial intelligence, can allow the production of different thematic geospatial maps, data and tools, to meet the needs of different users and stakeholders at different scales and contribute to the monitoring and managing of forests with an ecosystem-based approach (Box 1). The Decade is providing opportunities and tools to improve the monitoring of restoration at the global level, and the Mediterranean region can play an active role in this respect. The momentum could be used to enhance restoration efforts at the regional level and showcase the results produced so far (Box 2)(for more information on the role of the Mediterranean region in the Decade, see article by Romero Montoya *et al.* on p. 30).

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The Mediterranean Forest Research Agenda and land degradation in the Mediterranean region

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Degraded formation of Atlas Pistachio and Wild Olive in the Benslimane region of Morocco: soil erosion, runoff, and badland formation

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Introduction

The Mediterranean region faces various environmental challenges, such as soil erosion, desertification, deforestation and biodiversity loss. The region's vulnerability is also exacerbated by the escalating impacts of climate change and population growth (Gauquelin *et al.*, 2018; Peñuelas *et al.*, 2017). Seeking to navigate this complexity, scientific research on forests emerges as a vital beacon, offering evidence-based solutions to foster a more sustainable and resilient coexistence between Mediterranean forests and their evolving environment.

Despite the pivotal role of research, the history of forest research in the Mediterranean has been marked by hurdles: fragmented structures, limited resources, occasional obsolescence and isolation. Compounding these challenges is the struggle to get adequate funding, which can be attributed to the perception that Mediterranean forests yield fewer benefits to industries compared to their counterparts outside the region, thereby hampering private sector interest and funding (Nardi *et al.*, 2016). Despite these obstacles, several organizations and institutions are working on Mediterranean forest-related topics. To harness collective efforts and coordinate actions, the need for a forest research agenda specific to the Mediterranean context becomes paramount. Such an agenda establishes priorities and identifies research gaps while charting a course for long-term planning, securing policy support and sparking effective collaboration among stakeholders.

The initial steps towards a unified agenda were taken by the European Forest Institute's Mediterranean Facility (EFIMED) (2009), with a subsequent update in 2022 (Bou Dagher Kharrat *et al.*, 2022). This article presents the Mediterranean Forest Research Agenda (MFRA) 2030, delving into its research topics and placing a particular focus on the critical issue of forest land degradation.

The status of the Mediterranean Forest Research Agenda

The status of Mediterranean forest research is reflected in the new MFRA 2030 published in 2022 (Bou Dagher Kharrat *et al.*, 2022). It builds on the past decade's achievements, offering a new shared vision for Mediterranean forest research priorities, innovations and actions. The EFIMED network, and the broader Mediterranean forestry community have recognized the achievements of the previous research agenda and have reflected on the gaps: their views are summarized in the MFRA 2020 Survey Report. Since the formulation of the first Mediterranean Forest Research Agenda 2010–2020 (EFIMED, 2009), climatic, ecological, socioeconomic and (geo) political changes have continued to adversely affect the socioecology of Mediterranean forest systems. Urgent action is needed to strengthen their resilience in line with new key forest management strategies.

The MFRA 2030 outlines the complex context surrounding Mediterranean forests, shaped by farmland abandonment, increased forest cover, human demographic changes, agricultural and hydrological pressures, climate change, and other factors. The agenda takes into account the broader socioeconomic and politically "wicked" problems that put pressure on forests while considering the multifunctionality of forests and the broad range of often undervalued ecosystem services they provide. The MFRA seeks to offer a common vision for the future of Mediterranean forest research by integrating the inputs of diverse stakeholders in identifying high-impact intervention points and aiming at better-informed policymaking.

Consultations have defined four priority areas to be addressed over the coming years, and scientific review papers were commissioned by EFIMED to address: i) **forest resilience** in a context of global change-related forest disturbances (Peñuelas and Sardans, 2021); ii) conservation and management of **biodiversity and forest genetic resources** (Fady *et al.*, 2022); iii) forest management addressing trade-offs and synergies between **multiple ecosystem services** (Nocentini, Travaglini and Muys, 2022); and iv) **social and business innovations and policy instruments** for operating within the Mediterranean forest-based bioeconomy (Secco *et al.*, forthcoming). Each priority thematic area is articulated in greater detail: it offers key research questions, suggests research approaches, and considers associated opportunities and challenges, supported by several research recommendations.

Theme 1. Forest resilience research will help address the fossil energy crisis, maintain biodiversity and mitigate wildfire risks. It will also contribute to hierarchical landscape planning and avoid landscape homogenization and excessive biomass accumulation.

Theme 2. Forest biodiversity conservation and management research will help improve seed sourcing and forest restoration. It will extend the available data on tree functional traits (like life form or leaf carbon content), tree distribution, and seed dispersal modes, across the whole of the Mediterranean region. This will allow to better support machine learning. Research will also help identify best management practices, and broaden genetic diversity in Mediterranean forest policy, conservation and management.

Theme 3. Research will consider managing trade-offs and synergies between multiple forest ecosystem services. It will improve our understanding of forest dynamics to secure the "option(s) of choice" for future generations and develop inventories for multifunctional forest-management planning. Research will favour multidisciplinary, holistic approaches that respect the landscapes' cultural heritage, contribute to biodiversity conservation, and offer adaptive potential for future climate and other global changes.

Theme 4. Research will explore social, business and policy innovations for a more dynamic Mediterranean forest-based bioeconomy. It will help build capacity and leadership in these areas. It will also examine different multidisciplinary approaches and help develop business models that could best harness their potential. Findings will also enable new knowledge transfer to policymakers and practitioners to convert scientific research into action.

The implementation of the MFRA 2030 will prioritize topics for immediate action and for suitable support. The agenda highlights the need to address regional disparities in land ownership, stakeholders, communities and ecosystems. The MFRA 2030 will continue to build a Mediterranean forestry knowledge triangle of research, education and innovation, based on its geographic triangle with vertices in Mediterranean Europe, and Southern and Eastern Mediterranean regions. The implementation of the agenda will require a coordinated effort by the research community and related stakeholders, supported by training curricula and scientific exchanges. It will also require sufficient resources, not least funding.

The role of research in restoring Mediterranean degraded land

Land degradation is notably pronounced in the Mediterranean region, particularly in semi-arid and dry areas, making them vulnerable to environmental changes and requiring attention from both scientific and policy perspectives. Land degradation implies changing ecological processes whereby soil fertility is progressively reduced. Without corrective measures, such processes may lead to irreversible desertification and loss of original agricultural and forestry productivity, from both the ecological and the economic perspectives (Daza C. *et al.*, 2019; D'Odorico *et al.*, 2013; Ferrara *et al.*, 2016). The United Nations has designated 2021–2030 as the United Nations Decade on Ecosystem Restoration (the "Decade"), which aims to accelerate the restoration of degraded ecosystems globally to achieve the Sustainable Development Goals (SDGs) and post-2020 biodiversity targets in a timely manner. The Decade aligns with the targets of the Bonn Challenge and other ongoing restoration initiatives, providing an ideal framework for Mediterranean research to converge and support on-the-ground practitioners and contribute significantly to the reversal of land degradation. This research acts as a foundation for informed decision-making, guiding the development and implementation of restoration projects in the Mediterranean region. A well-informed, evidence-based approach increases the likelihood of successful and sustainable outcomes in the restoration of degraded land. Restoration of degraded land was underlined by the MFRA 2030 as of paramount importance. Here are some key roles that research may play in the restoration of degraded land in the Mediterranean:

Understanding the causes of degradation: Research helps identify the specific factors and drivers of land degradation in the Mediterranean region. This includes studying the impact of climate change, human activities

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Relict population of Cedrus libani holding precious genetic resources in the Jaj Nature Reserve, Mount Lebanon

like agriculture, urbanization and tourism, and natural processes (e.g. wildfires). Understanding the root causes of degradation is essential for developing targeted restoration strategies.

Assessing current ecosystem functioning: Research helps evaluate the current state of ecosystems in the Mediterranean, including their biodiversity, their soil health and their hydrological processes. This baseline information is crucial for measuring the success of restoration efforts and for guiding future ecosystem management decisions.

Developing restoration techniques: Research is essential for developing and testing restoration techniques tailored to the Mediterranean's unique environmental conditions. This can involve studying the use of native plant species, agroforestry practices, erosion control methods, and sustainable land management approaches.

Monitoring and evaluation: Continuous research is needed to monitor the progress and effectiveness of restoration projects over time. This involves assessing changes in soil quality, vegetation cover and water retention, among other indicators, to ensure that restoration efforts are achieving their intended goals.

Climate adaptation: Given the Mediterranean region's vulnerability to climate change, research can help identify strategies for adapting restoration efforts to changing climate conditions. This may involve selecting drought-resistant plant species or designing water management systems that account for increased variability in precipitation.

Adjust policy and governance: Research can inform policymakers and stakeholders about the importance of land restoration and the benefits it brings in terms of ecosystem services, carbon sequestration and resilience to climate change. It can also help identify effective policy measures and governance structures to support restoration initiatives.

Knowledge sharing and capacity building: Research findings can be disseminated to local communities, land managers and organizations involved in restoration efforts. This knowledge-sharing process is essential for building capacity and ensuring that best practices are adopted widely.

Foster international collaboration: Collaboration between researchers, institutions and organizations at regional and international levels can enhance the effectiveness of restoration projects. Shared knowledge and resources can lead to more comprehensive and successful restoration initiatives.

Research plays a crucial and varied role in restoring degraded land in the Mediterranean region. It serves to diagnose the causes of degradation, develop appropriate solutions and monitor progress, ensuring that restoration efforts are sustainable, adaptive and well informed. This interdisciplinary approach is essential for tackling the complex challenges of land degradation in the Mediterranean and fostering ecological resilience in the face of ongoing environmental changes.

Conclusion

The significance of research is underscored by the status of the MFRA 2010–2020 and its transformation into the MFRA 2030. This strategic agenda, shaped by the collaboration between EFIMED and the wider Mediterranean forestry community, reflects the dynamic socioecological context of Mediterranean forest systems. The agenda recognizes the urgency of actions needed to enhance the resilience of these systems in the face of ongoing changes. As the MFRA 2030 moves from vision to implementation, it calls for a coordinated effort from the research community and stakeholders, emphasizing the importance of training, scientific exchanges and appropriate funding. The success of this agenda hinges on a collective commitment to translate research findings into tangible actions to foster resilience, conserve biodiversity, manage ecosystem services and promote a sustainable bioeconomy. In essence, research not only charts a path forward for protecting and enhancing Mediterranean forests but also serves as the cornerstone for effective restoration efforts in the region, ensuring its ecological resilience in the face of complex and interconnected challenges.

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Volunteers from the Association for Forests, Development and Conservation (AFDC) preparing pine seedlings for planting as part of a reforestation project monitoring forest fires, Ramlieh, Chouf Mountains, Lebanon

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Upscaling forest and landscape restoration in the Mediterranean region: key achievements in Lebanon and Morocco

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Introduction

The Mediterranean region is a living testament to the coexistence of rich biodiversity and ancient civilizations. Yet, the impacts of human activity, including deforestation, overgrazing and urban expansion, are visible throughout its landscapes of once pristine forests, rangelands and other diverse ecosystems. While our understanding of the full scope of ecosystem degradation in this region remains limited, estimations show that approximately one-third of the land is already affected by degradation, caused by unsustainable land management practices (PRIMA, 2022).

Against this alarming backdrop, the push for ecosystem restoration is gaining ground. Whether in Europe, North Africa or the Near East, Mediterranean nations are redoubling their efforts to restore and breathe new life into degraded landscapes. Further, these countries are increasing their awareness-raising efforts about the huge losses that could result from ecosystem degradation while simultaneously integrating landscape rehabilitation into national policies and strategies. Guiding and underpinning such initiatives is the Forest and Landscape Restoration Mechanism (FLRM), established by FAO in 2014. Since its creation, the FLRM has supported countries in upscaling restoration endeavours throughout the Mediterranean region.

This article presents the national results of the 2018–2024 project "The Paris Agreement in Action: Upscaling Forest and Landscape Restoration to Achieve Nationally Determined Contributions" funded by the International Climate Initiative (IKI) of the German Federal Ministry for Economic Affairs and Climate Action and implemented by the FLRM. The project aims to demonstrate the high potential of forest and landscape restoration (FLR) options in the context of the Bonn Challenge, in helping countries achieve their nationally determined contributions (NDCs), by promoting joint mitigation and adaptation approaches in Africa, the Pacific Islands and the Mediterranean region, the latter being the focus of this article. The Mediterranean component of the project includes activities to support the regional restoration dynamic, including two national components in Lebanon and Morocco. Because of its relevance at the Mediterranean level, the project has been labelled by the Union for the Mediterranean (UfM) for its direct contribution to the implementation of the UfM Ministerial Declaration on Environment and Climate Action adopted by the 42 countries of the UfM in Cairo, Egypt, on 4 October 2021.

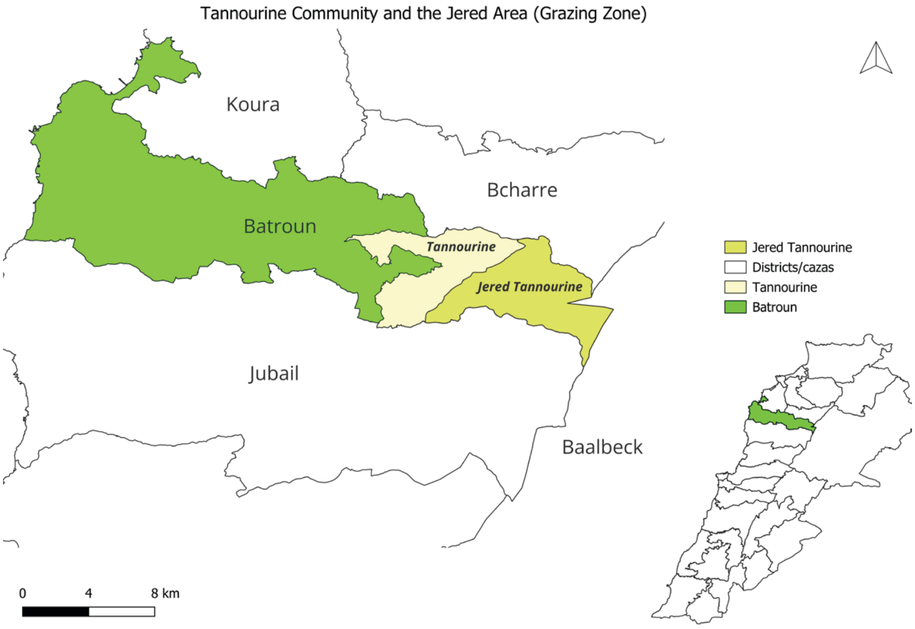

Figure 1. Location of the Tannourine community and Jered Tannourine, the communal land used for grazing

Forest and landscape restoration activities in Lebanon

The cedar forests of Lebanon are perhaps its most famous natural heritage, but they are only a small part of the rich tapestry of biodiverse landscapes that can be found across the country. Yet, the impact of human mismanagement has left its mark on the landscapes of Lebanon: 60 percent of the land is threatened by human-induced degradation (Darwish, Faour and Khawlie, 2004), and nearly 40.5 percent is at risk of desertification (Darwish *et al.*, 2012). Abdallah *et al.* (2018) estimated a USD 74 million loss per year in the Lebanese agricultural sector due to land degradation.

The Government of Lebanon has taken action to combat land degradation, working alongside civil society partners to launch ecosystem restoration programmes. The recurrence of forest fires has brought the agenda of forest restoration to the forefront, especially after the large-scale fires of 2007, which burned approximately 6 000 hectares (ha) of forests and grasslands (Majdalani *et al.*, 2022). Afforestation and reforestation were considered essential restoration actions, paving the way for the National Afforestation and Reforestation Plan (NARP) developed in 2012. With the ambitious goal of increasing the forest cover of Lebanon from 13 percent to 20 percent by 2030, the NARP brought together a diverse range of stakeholders to collaborate on a clearly defined objective. However, reaching this goal proved a challenge. The high costs of planting, inefficiencies in reforestation efforts, differences in the techniques used by local actors, and a legal framework dating back to 1949 were major hurdles. The implementation of forest restoration activities revealed that simply planting trees was not enough to meet national environmental objectives. Further, the value of ecosystem conservation beyond forests had gained recognition at that point. Lebanon was also facing additional challenges, which diverted the attention away from ecosystem restoration efforts. The Syrian civil war resulted in over 1.5 million displaced Syrians living in Lebanon, with the country having the highest refugee count per capita in the world (ECHO, 2022). Further, Lebanon's economy experienced a severe collapse in 2019. This crisis plunged a significant portion of the population into poverty, making it difficult to meet basic needs. The situation was further compounded by the COVID-19 pandemic and the catastrophic explosion at the Beirut Port in 2020.

The role of the Forest and Landscape Restoration Mechanism in Lebanon

Recognizing Lebanon's complex national context, the FLRM's restoration

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Photo 1. Grazing in the highlands of Tannourine

efforts switched focus in 2019, moving away from the culturally significant stone terraces implemented from 2016 to 2018. This new phase was directed at large-scale restoration and improving the management of productive landscapes, particularly rangelands.

Focus on rangelands

As the need to manage ecosystems beyond forests became evident, FAO and the Ministry of Agriculture (MoA) shifted the FLRM's activities to the management of rangelands because of their importance for local livelihoods and national food security. The collaboration between the MoA and FAO resulted in the implementation of a pioneering initiative aimed at enhancing the management of natural resources and rangelands and supporting local communities. This was achieved through the following approach:

- **Site selection:** The site selection process included detailed field assessments, consultations with local stakeholders, and a review of the area's environmental and socioeconomic benefits and the level of interest of local communities. The site of the Tannourine community in the North of Lebanon was deemed to be the ideal candidate (Figure 1).
- **Technical approach:** The "National Guidelines for Rangeland Management" developed by the United Nations Development Programme (UNDP) Lebanon and endorsed by the MoA provided a detailed and clear technical approach.
- **Community engagement and field assessments:** After extensive talks with the municipality, shepherds and other local stakeholders, and a review of the Tannourine municipality's master plan, smaller, more manageable rangeland management units were identified. Field assessments during two seasons in 2020 and 2021 were carried out to measure resource distribution and abundance and determine critical metrics, including carrying capacity and stocking rate for each unit.
- **Management plan development:** Based on these measurements and calculations, and field observations, previous studies and discussions with local actors, the project team developed a 10-year rangeland management plan. The plan was refined and adjusted following consultations with local stakeholders. It promotes rotational grazing, defines the maximum number of animals that can enter the sites, and offers support measures to the shepherds.
- **Initiation of field activities:** With the management plan in place, a locally active civil society organization, Tannour Wa Nour, was approached by FAO to collaborate with the MoA and the Tannourine municipality on the implementation of the activities described in the management plan. Through field visits, the local partner monitored the shepherds' activities, engaging with them and gathering socioeconomic data (Photo 1 and Photo 2).
- **Upcoming activities:** FAO, the MoA, the Tannourine municipality and Tannour Wa Nour will continue to engage with the shepherds to ensure that they comply with the designated grazing areas. Further, the project will provide the shepherds with feed and veterinary medicine to ensure that they continue to support the goals of the management plan over the longer term.

Promotion of knowledge sharing

The MoA and FLRM remain committed to fostering a culture of knowledge exchange among Lebanese stakeholders involved in land management and

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Photo 2. Collecting field data: 25 m long transects with plant data recorded every 25 cm

restoration. This is crucial since one of the barriers to implementing large-scale restoration projects was found to be the lack of consistency among land management techniques applied by different stakeholders (e.g. diverging restoration and monitoring approaches). The project is supporting the organization of a series of technical one-day events addressing important topics such as the identification of common rangeland plants (e.g. annual and perennial grasses and forbs, shrubs and trees), forest fire preparedness and management, and post-fire restoration. Local partners such as the Association for Forests, Development and Conservation (AFDC) and the Lebanon Reforestation Initiative (LRI) were able to share their field restoration experiences spanning over 15 years while working in various Lebanese landscapes, and to explain why some were more successful than others.

A rich array of subjects will be tackled in the upcoming technical days. These include exploring the role of agroforestry in bolstering food security and conserving biodiversity, identifying the principles that underpin successful land restoration, understanding the potential impacts of invasive species on native flora and fauna, and delving into comprehensive rangeland and forest management techniques.

Strengthening the legal framework for the management of forests and rangelands

Having an appropriate, up-to-date legal framework is an important pillar for the sustainable management of natural resources like forests and rangelands. The forest code of Lebanon dates back to 1949, and while the basic tenets of the code are still valid, an in-depth revision was deemed necessary. This was due to several factors, including:

- a changing climate, which is putting increasing pressure on forests and rangelands;
- the growing demand for forest products and services, such as timber, fuelwood and recreation;
- the increasing occurrence of forest fires and other natural disasters; and
- the need to better integrate the management of forests and rangelands with other land uses, such as agriculture and tourism.

The revision process is being led by the MoA and consists of three phases namely:

- a detailed review of the existing forest code to identify its strengths and weaknesses;
- consultations with a wide range of stakeholders, including government agencies, non-governmental organizations (NGOs) and the private sector, to gather feedback on the proposed revisions to the forest code; and
- drafting of the revised forest code, incorporating the feedback from the consultations.

The revised forest code is a comprehensive document that addresses all aspects of forest and rangeland management. The code includes provisions on multiple aspects of forests and rangelands, including:

- definitions
- tenure systems
- management
- uses, products and services
- sustainable management

The revised forest code is currently being reviewed for linguistic accuracy and clarity. Once the review is complete, the code will be sent to line ministries for their comments and approval. This process can be time-consuming; however, it is necessary for the revised code to be approved nationally. The approval of the revised forest code will be a major national milestone as it will provide a solid foundation for the sustainable management of Lebanon's forests and rangelands and will help improve the livelihoods of the people that depend on them.

Forest and landscape restoration activities in Morocco

Restoration in national policy instruments and the updated nationally determined contribution

The national policy instruments of Morocco fully integrate the restoration of degraded forests and lands. The recent forestry strategy, "Forests of Morocco 2020–2030", includes a reforestation goal of 500 000 ha by 2030 at a rate of 50 000 ha per year and focuses on a participatory approach for restoring degraded forest land. At the same time, the National Sustainable Development Strategy 2017–2030 highlights the need to reduce land degradation and promote the sustainable management of natural resources, including restoration.

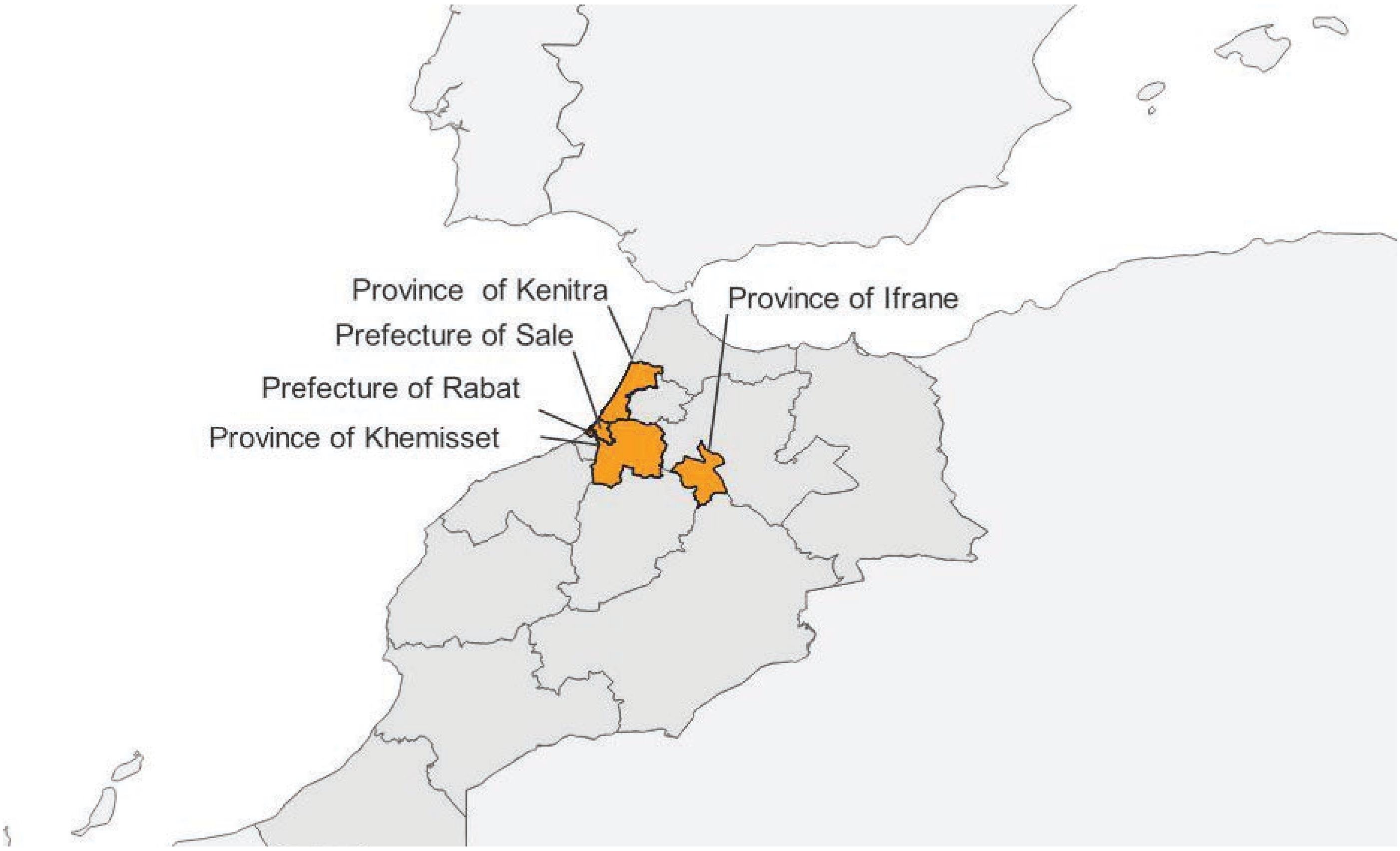
Since its inception, the Paris Agreement in Action project has supported the integration of forest and landscape restoration in national strategies. Technical studies have been conducted by national experts to fine-tune national reporting and submissions, comprising an assessment of wood productivity, annual growth rates of forest species, and fuelwood removals, and the production of data for inclusion in the national inventory of greenhouse gases (GHG). The results have been consolidated into the national communications and biennial reports.

In addition, in June 2021, with the support of the project, Morocco submitted its revised NDC to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), raising its ambition to reducing GHG emissions by 45.5 percent by 2030. In the revised NDC, the restoration of degraded forests and landscapes plays a key role, with the forest sector positioned at the forefront of national efforts to combat climate change and reduce GHG emissions. The actions planned by the revised forestry NDC are structured around key forestry components in four areas: i) ecosystem restoration (reforestation and afforestation); ii) avoided degradation; iii) sustainable management; and iv) strengthening the resilience of socioecosystems in vulnerable areas.

The mitigation actions proposed in the revised NDC aim to improve the carbon sink function of forest ecosystems. The forestry actions selected for mitigation have a cumulative reduction potential for 2020–2030 of nearly 7 503 and 3 592 million tonnes CO_2-equivalent (tCO^2eq) respectively for unconditional and conditional targets, that is, a projected reduction of approximately 11 700 million tCO_2eq. The cost of implementing these actions amounts to USD 2 800 million over the entire implementation period and requires an estimated financial support for conditional actions of approximately USD 829 million.

The unconditional target for adaptation by 2030 is the creation of 300 new community groups and cooperatives for participatory forest management (*structures solidaires de gestion*

Figure 2. Location of the pilot sites in Morocco



Note: The Maâmora Forest is managed by the Rabat-Salé-Kénitra Regional Department of the National Water and Forestry Agency, the province of Kenitra and Sidi Slimane (for its northern half), the province of Khemisset and Salé (for its southern half). Two other pilot sites are located in the regional directorates of the National Water and Forestry Agency in Fes-Meknes, province of Ifrane, and Béni Mellal-Khénifra, province of Ifran Midelt.

Source: Adapted from United Nations Geospatial, 2005. Morocco. [Cited 1 June 2024]. https://www.un.org/geospatial/file/2114/download?token=7edRnazL

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Photo 3. Adult and young cork oak (*Quercus ilex L.*) specimens in the Maâmora Forest.

forestière participatives), as well as 200 forestry development organizations (*organismes de développement forestier*), which will assist in the planning of the various programmes of action. Other targets are 500 000 ha of watershed management work involving fixing gullies and treating soil erosion to achieve the National Watershed Management Plan objective of managing 1.5 million ha in 22 priority basins, in addition to the creation of 240 km per year of forest tracks by 2030.

Restoration activities on the ground

The Maâmora Forest and the province of Ifrane were selected as pilot sites for field activities (Figure 1).

Located in the north of the country, the Maâmora Forest is considered the largest cork oak forest in Morocco and in the Mediterranean region. Covering 132 000 ha, it serves as a recreational area for the residents of major cities such as Rabat, Salé, Khemisset and Kenitra, and provides diverse sources of livelihood from a variety of non-wood forest products and services, including cork, acorn harvesting and grazing, for a growing local population estimated at 234 000 forest residents. Since 1918, the forestry administration of Morocco has put in a great deal of effort into the conservation and development of forestry in the region. However, this cork oak forest is at risk from by unsustainable human activities, including overgrazing and acorn gathering. Combined with the effects of climate change, this is causing the degradation of the forest and affecting the potential for natural regeneration. Thanks to the project's support, almost 1 500 ha of cork oak forests are currently under restoration (Photo 3).

With support from FAO, the ministry's National Water and Forestry Agency has developed a participatory development plan in a pilot area in the commune of Sidi Taibi, incorporating participatory socioeconomic approaches, to ensure that local communities can play a central role in restoration and conservation efforts to rehabilitate the forest. The development plan includes the establishment of partnership contracts with local communities to ensure the implementation of restoration interventions. This involves the development of new value chains (e.g. truffle harvesting; see Box 1) to provide alternative income streams for local forest-dependent communities.

Degraded areas with potential for restoration were identified through a comprehensive assessment of existing restoration best practices, together with a socioeconomic study reviewing the current impact of local communities on key forest resources. The development plan included a pilot test on 3 423 ha in Sidi Taibi with the involvement of local community organization El Mostakbal Eraaouia-Zdagh. Protected plots have been established onsite with regeneration success rates of 50–80 percent, and almost 200 ha have already been restored since the finalization of the development plan. Implementation in the field is being funded through domestic resources in the form of co-financing.

A similar process is being undertaken by the project at a second pilot site in the jurisdictions of the National Water and Forestry Agency's regional offices in Fes-Meknes, province of Ifrane, and Béni Mellal Khénifra, province of Midelt. The goal is to implement a

Box 1. Developing the truffle value chain in the Maâmora Forest

In the Maâmora Forest (and in Morocco in general), truffles and desert truffles (*Terfeziaceae*) are fungi of high economic and ecological value. They are edible and considered important species for the seasonal and local trade, with multiple uses, notably in the pharmaceutical and food industries. The species form a mycorrhizal association with several desert shrubs, protecting the soil from degradation and improving plant growth in semi-arid and desert areas.[i] Given their importance, they deserve to be protected, studied and used sustainably for the benefit of local communities and the environment.

According to past and recent ecological and biological studies,[i,ii] the truffles can be integrated in forest management programmes, particularly for the rehabilitation of degraded sites and in reforestation in general.

A research protocol to move from random to controlled and sustainable production has been developed. The aim is to provide the value chain with technical solutions through different cultivation practices adapted to changing climatic conditions and increasing anthropogenic pressure. The protocol is based on a multidisciplinary approach and will allow for the ecological characterization of natural production sites, the development of reliable methods for producing quality planting material, thereby enabling cultivation to be extended to previously unproductive areas, and the development of appropriate cultivation practices.

The proposed protocol includes: i) selecting and delineating natural production sites and determining soil, climatic and plant characteristics; ii) identifying the various species present using biochemical and molecular analyses; iii) isolating these species in pure cultures; iv) preparing spore and mycelial inocula; v) controlled mycorrhization in greenhouses and nurseries; and vi) field studies on the effects of artificial mycorrhization and cultivation practices such as irrigation, mulching, thinning, pruning and fencing, for producing desert truffles. Depending on the results obtained with the techniques tested, more in-depth research will be planned.

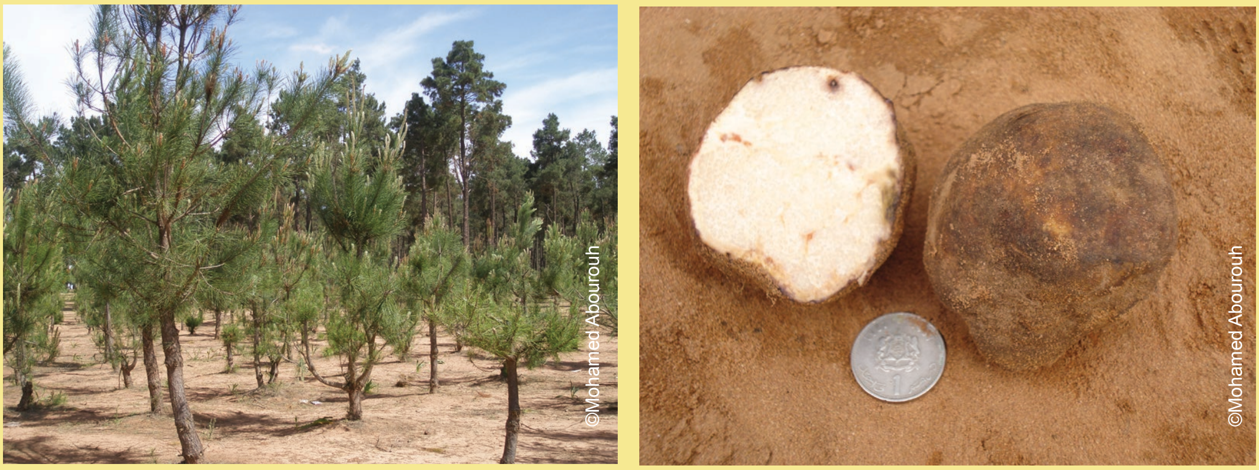

Figure 6 a and b. Natural desert truffle growing area and close-up of a desert truffle

Sources: Abourouh, M., Hajib, F.S., Dhman, L., Elantry, S., Magri, N., Jalila, A., Oubrahim, H., Mohamed, O. & Abdelhamid, G. 2022. *Mise au point d'un protocole expérimental de culture de Terfess en la forêt de la Maâmora (Maroc) [Developing a protocol for testing the cultivation of desert truffles* (Terfeziaceae) *in the Maâmora Forest, Morocco].* XV World Forestry Congress. https://openknowledge.fao.org/server/api/core/bitstreams/6a98938e-1038-4e65-8644-dbf173f67226/content

[i] Henkrar, F., Meyad, C., Sabaa, S. & Khabar, L. 2022. Desert Truffles and Truffles in Morocco: Biodiversity of Promising Fungi to Combat Desertification. *environmental sciences proceedings*, 16(35). https://doi.org/10.3390/environsciproc2022016035

[ii] Khabar, L. 2022. *Les Terfess et les Truffes du Maroc: Biodiversité et Valorisation*. Editions universitaires européennes.

similar participatory approach but in a different context. There are fewer hectares to restore (less than 100 ha) compared to the Maâmora Forest site, but the intention is to involve local actors and communities at each stage of the process. Technical aspects of the intervention, such as selecting the species, seedling quality, soil preparation method and irrigation regime, relevant to improve restoration outcomes, are being discussed and addressed collectively. Before the intervention, the local communities have been made aware of the restoration project and the project's aim to enhance their livelihoods and well-being. Educational activities addressing environmental topics at meetings, workshops and field visits, are being conducted to contribute to a long-term process of mutual learning (McCann, 2011), allowing feedback from local stakeholders to be integrated in practices.

Conclusion

Restoration is gaining attention at the global level thanks to many recent initiatives guided by the United Nations Decade on Ecosystem Restoration 2021–2030 ("the Decade"). The Paris Agreement in Action project has been playing a key role in enhancing restoration at the regional and national level in the Mediterranean basin since its launch in 2018. It aims to scale up restoration by creating an enabling environment and demonstrating, through pilot activities applying appropriate FLR approaches, how restoration can contribute to achieving national and global restoration targets, including the NDCs, Aichi targets and the Kunming-Montreal Global Biodiversity Framework and Bonn Challenge, and Sustainable Development Goals, and to providing major carbon and non-carbon benefits, including water, biodiversity and livelihoods.

The project is contributing to establishing a powerful regional dynamic on restoration, which has supported the organization of high-level events gaining the political attention of governments. Restoration was promoted at events like the Sixth and Seventh Mediterranean Forest Weeks in Lebanon in 2019 and in Türkiye in 2022, with the endorsement of, respectively:

- The Brummana Declaration in 2019, which confirmed the Agadir Commitment[13] of 2017 with a regional Mediterranean initiative on FLR.
- The Antalya Declaration in 2022, which calls for countries and other stakeholders to scale up restoration efforts and strengthen regional cooperation in order to address common environmental and climate challenges. It emphasizes that restoration can create employment and reconnect Mediterranean people to their landscapes and help build climate resilience in the region.

At the national level in both Morocco and Lebanon, the activities have highlighted the need to strengthen the role of restoration in national strategies and on the ground, with better coordination and collaboration among different stakeholders.

The dialogue on restoration enabled by the project has continuously supported actions at the regional and national level, thus paving the way for an active contribution of the Mediterranean region to the Decade. With new opportunities like the World Restoration Flagships and the documentation of best practices, there will be space for the region to disseminate the rehabilitation and restoration results achieved in degraded areas in recent years, thereby boosting further efforts and collaborations.

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[13] Adopted in 2017 at the Fifth Mediterranean Forest Week in Morocco, the Agadir Commitment aims to restore 8 million ha of degraded Mediterranean land by 2030.

Mediterranean fire weather and restoration perspectives in a changing climate

©Sahbi Bedhiaf

Dj ElMsid fire in Béja Governorate, Tunisia, August 2022

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Wildfires in the Mediterranean

Mediterranean ecosystems are among the most diverse in the world in terms of animal and plant species (Médail and Quézel, 1999; Blondel *et al.*, 2010). However, in recent decades, these ecosystems have experienced rapid degradation due to various threats. In addition to human-induced disturbances (e.g. overgrazing and agricultural and urban expansion), which have led to significant degradation over the years, Mediterranean forest ecosystems are also exposed to various natural disturbances. For instance, major pest outbreaks have led to diebacks, especially in Tunisian and Lebanese forests (Touhami *et al.*, 2020; Moussa, Choueiri and Hanna, 2021; Hlaiem *et al.*, 2023), drought in Algeria has caused the decline of cedar populations (Navarro-Cerrillo *et al.*, 2021), and wildfires are burning hundreds of thousands of hectares every year in the region (San-Miguel-Ayanz *et al.*, 2022). These disturbances are often interconnected, creating cascading effects that are exacerbated by global warming (Resco de Dios, Fischer and Colinas, 2007; Bellahirech *et al.*, 2019; Peñuelas and Sardans, 2021).

Climatic conditions are changing in the region, as winters are becoming milder and summers hotter and drier (Guiot and Cramer, 2016). Furthermore, extreme weather events, such as heat waves and dry spells, are occurring more often and are expected to become more severe in the future (Raymond *et al.*, 2020; Ali *et al.*, 2022). This has led to an increase in the length of the fire season and the intensity of wildfires in the Mediterranean basin (Ruffault *et al.*, 2018; Eberle and Higuera Roa, 2022; Rodrigues *et al.*, 2023).

Although wildfires have historically been part of the regional dynamics and many Mediterranean species are adapted to fire (e.g. some *Quercus* spp. and *Pinus* spp.) (Pausas, 1997; Ne'eman and Arianoutsou, 2021), every year Mediterranean forests face wildfires[14] that threaten the biodiversity of ecosystems and the lives of local populations. Wildfires are among the disturbances causing the most damage in some Mediterranean countries (Seidl *et al.*, 2014). The years 2021 and 2022 saw particularly devastating fires in the Mediterranean, with burnt surface areas reaching alarming levels. In 2021, fires burned around half a million hectares of forests and agricultural land in Italy, Türkiye, Greece, and Algeria (San-Miguel-Ayanz *et al.*, 2022). In the last few years, wildfires in the Mediterranean have overwhelmed firefighting capacity, due to intensities exceeding the limits of suppression and fires sometimes occurring simultaneously. The years 2013 and 2017, for example, were particularly bad in Portugal, where more than 300 000 hectares (ha) burned and 117 people died (Ribeiro *et al.*, 2020).

In 2021, more than 50 000 ha burned in Greece on Evia Island alone (Figure 1), this being the country's largest fire to date, burning mainly forest land (Giannaros *et al.*, 2022). Similarly, in Türkiye, almost 140 000 ha of forest were burnt in several megafires in early August 2021 (Atmiş *et al.*, 2023). In Algeria, a series of fierce wildfires burned over 100 000 ha of forest and agricultural land. According to the Algerian authorities, more than 50 fires were recorded in 16 wilayas (provinces) in the country between June and August 2021, damaging homes, public buildings and infrastructure and resulting in more than 90 deaths (AfricaNews, 2021; Haddad and Hussein, 2021).

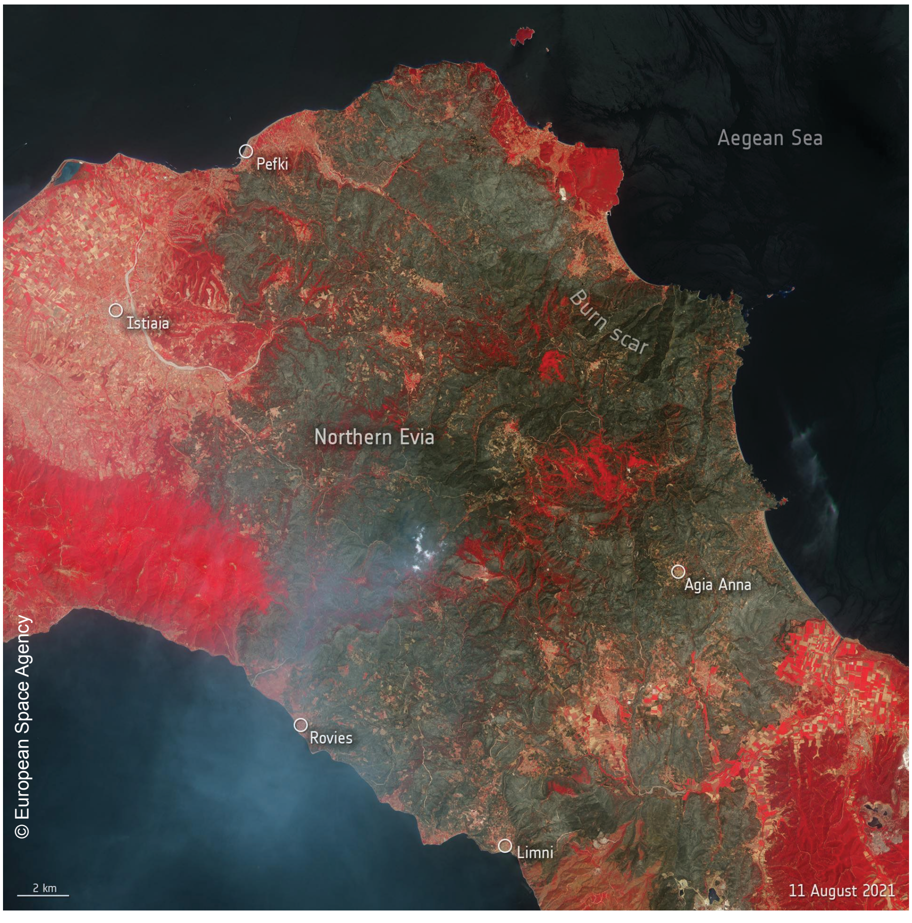
At the regional level, the situation got worse, 2022 becoming one of the most shocking fire seasons experienced for European, Near Eastern and North African countries, with over 1.6 million ha of land burnt and more than 250 000 ha affected in Greece, Italy, Spain, Algeria, Morocco and Tunisia (San-Miguel-Ayanz *et al.*, 2023). In 2023, further critical wildfires were witnessed throughout the region, and more than 100 000 ha of land had burnt by the end of July, mainly in Algeria, Greece, Italy and Tunisia (JRC, 2023).

Although wildfires in the Mediterranean are mostly associated with human activity, dry and warm weather conditions provide an enabling environment for fire occurrence and spread (Flannigan and Wotton, 2001; Abatzoglou *et al.*, 2021) and influence fire size and intensity (Hernandez, Drobinski and Turquety, 2015). In view of the alarming figures of the last few years, there is an urgent need for better anticipation and planning to prevent and fight wildfires in the Mediterranean region. A good understanding of fire regimes and future fire weather extremes in the region can help people prepare for future scenarios, *fire weather* meaning the influence of specific weather conditions that facilitate fire ignition and spread (Schroeder and Buck, 1970). Furthermore, initiatives such as integrated forest and fire management, promoting sustainable silvicultural and agricultural practices, and establishing monitoring systems, are essential to reduce wildfire impacts on ecosystems and the population, while regional cooperation is needed to address this shared problem.

Past and current situation

Fire has played an active role as an ecological disturbance throughout the evolution of the flora and fauna that make up Mediterranean ecosystems (Pausas and Keeley, 2009). For instance, paleoecological evidence of fire from plant material and charcoal in lake sediments stretches back over 13 000 years in Corsican black pine forests (Leys, Finsinger and Carcaillet, 2014). Marine sediments deposited by Iberian

Figure 1. Burnt area on Evia Island, Greece, in 2021. False-colour Copernicus Sentinel-2 image, where vegetation is represented in red and burnt areas in brown



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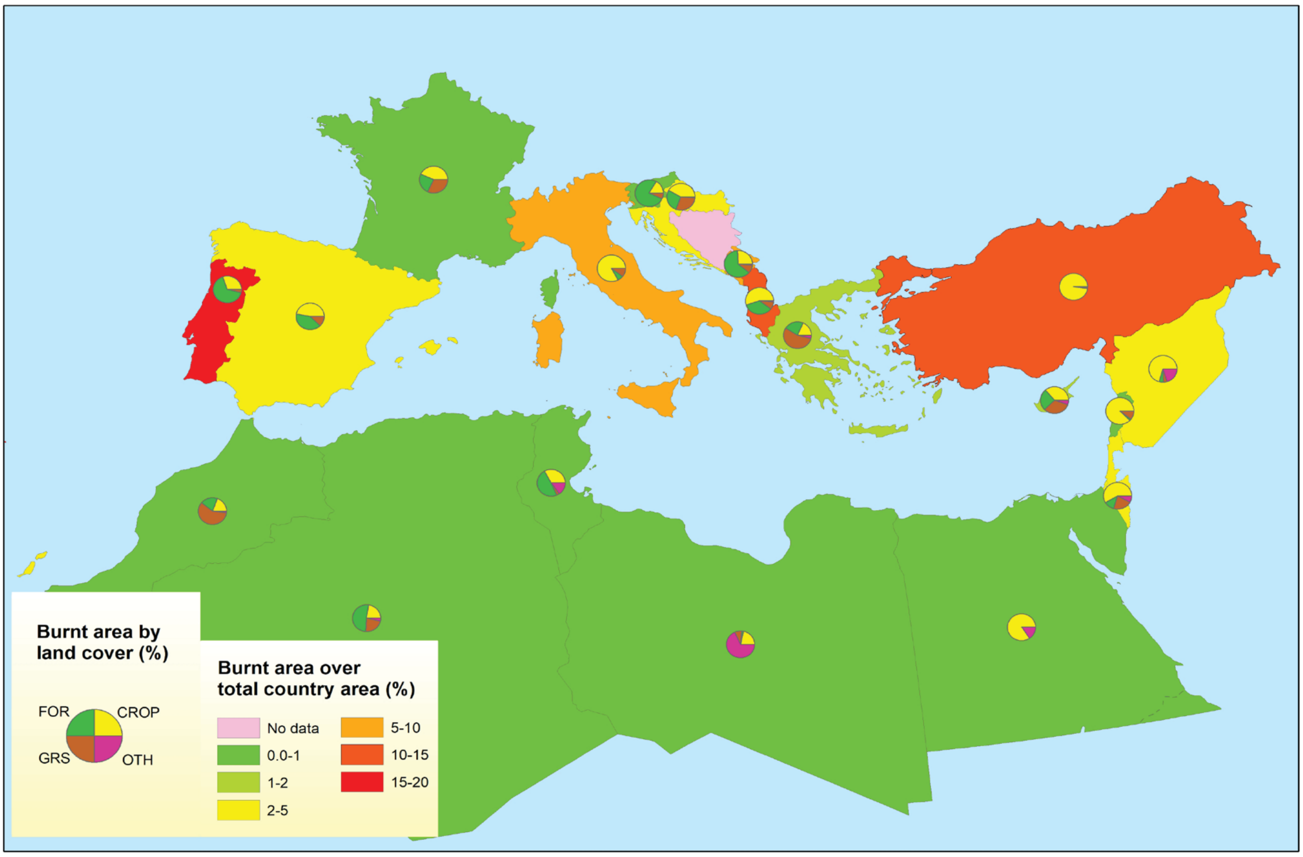
[14] The term "wildfire" in this paper uses the FAO definition (FAO, 2003): "Any uncontrolled fire in combustible vegetation that occurs in the countryside or a wilderness area. Other names such as brush fire, bushfire, forest fire, grass fire, hill fire, peat fire, vegetation fire, veldfire and wildland fire may be used to describe the same phenomenon depending on the type of vegetation being burnt."

Figure 2. Total burnt area (in percentage) over the total land area of the countries bordering the Mediterranean basin, and percentage of burnt area by land cover for each country


Burnt area by land cover (%)
FOR
CROP
GRS
OTH
Burnt area over total country area (%)
No data
0.0-1
1-2
2-5
5-10
10-15
15-20

Note: FOR: forest; CROP: cropland; GRS: grassland and shrubland; and OTH: settlements, wetlands and other land covers. Burnt area data for 2002–2019 provided by the Global Wildfire Information System (GWIS).

Source: EC (European Commission). 2023. *Global Wildfire Information System GWIS*. [Accessed on 13 June 2024]. https://gwis.jrc.ec.europa.eu/. CC BY 4.0.

rivers (5 000-year record, Genet *et al.*, 2021) and lake sediments in the Spanish Pyrenees (3 000-year record, González Sampériz *et al.*, 2019) provide evidence of fire recurrence and variability prior to large-scale human intervention, although in recent times human activities have modified fire regimes and biodiversity (Lestienne *et al.*, 2020). Tree-ring records provide shorter but more temporally and spatially explicit records of fire regimes, especially for the past 2–3 centuries in *Pinus nigra* forests in Spain (Fulé *et al.*, 2008), Greece (Christopoulou *et al.*, 2013) and Türkiye (Şahan *et al.*, 2022). Surface fire regimes in these forests were often altered after World War II but persist today in some areas.

The historical ecological and social importance of fire provides a useful context for looking at contemporary and expected future fire patterns. Furthermore, the knowledge of current patterns is enriched by annual statistics on burnt area and can provide, although for shorter periods than the paleoecological evidence, core information for (i) understanding the territorial, socioeconomic and climatic processes driving the fire phenomenon, (ii) identifying changes in fire regimes, and (iii) defining the strategies for fire management (Tonarelli *et al.*, 2020).

Here, we explore the information made available by the Global Wildfire Information System (GWIS) for the 2002–2019 period in order to highlight contemporary burnt area trends and patterns by year and land cover for the countries bordering the Mediterranean Sea, and their relationship with fire weather, and we then discuss recent changes in fire regimes. Through its interactive web applications,[15] GWIS provides data for historical burnt area at the country level for the 2002–2019 period, derived from MODIS MCD64A1. Data are collected and analysed considering four macroareas: 5 EU, representing the five southern European countries most affected by fires, namely France, Greece, Italy, Portugal and Spain; EAST EU, representing four countries from eastern Europe, namely, Albania, Croatia, Montenegro and Slovenia; N. AFR, corresponding to five North African countries, Algeria, Egypt, Libya, Morocco and Tunisia; and N. EAST, including five Near Eastern countries, Cyprus, Israel, Lebanon, the Syrian Arab Republic and Türkiye.

During that period, Near Eastern countries accounted for about 60 percent of the total burnt area in the Mediterranean region, mainly driven by Türkiye (Figure 2). The five southern European countries accounted for 29 percent of the total burnt area, Portugal and Italy being the most affected by fire, with 36 percent and 32 percent of the burnt area in this macroarea, respectively. The area burnt in eastern Europe and North Africa represented about 4 percent and 8 percent of the total burnt area in the region, respectively.

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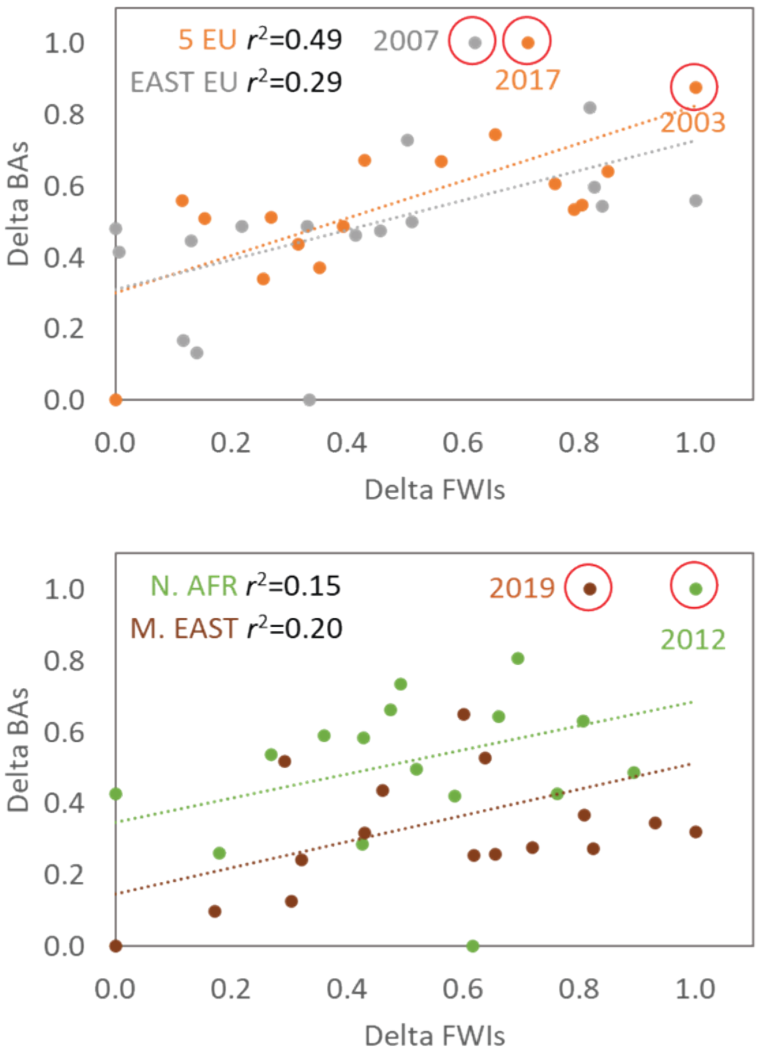
[15] Global Wildfire Information System: https://gwis.jrc.ec.europa.eu/

Regarding the land covers affected, cropland contributed 44 percent and 51 percent to the total burnt areas in eastern and southern Europe respectively, while forests contributed about 37 percent in both regions. On the other hand, in North Africa, cropland contributed 24 percent to the total burnt area, with forests contributing 50 percent. In the Near East, the main land cover burnt was cropland, contributing 95 percent to the total burnt area in the macroarea but varying from 36 percent in Cyprus to 97 percent in Türkiye (Figure 2).

Burnt areas have been directly linked to higher values of fire weather as represented by different fire weather indices (Camia and Amatulli, 2009; Ertugrul *et al.*, 2019; Moreira *et al.*, 2020). Following the approach by Moreira *et al.* (2020) and Ascoli (2023), and using the Canadian Fire Weather Index (FWI; Van Wagner, 1987), we found that a proportion of the interannual change in burnt area can be explained by changes in fire weather in the Mediterranean region (Figure 3). Looking at both forest and grassland fires during the fire season in the region (May–October), more severe fire seasons with higher mean daily FWI values correspond to more burnt area, as was the case in the five southern European countries in 2003 and 2007, and in the eastern European countries in 2007 (Figure 3). While in these regions the association is stronger, it is weaker for North African and Near Eastern countries.

Numerous studies concur that recent changes in fire regimes are related to multiple interacting drivers, such as land use, socioeconomic processes, and fire and forest management, which have undergone significant changes (e.g. Moreira *et al.*, 2011; Chergui *et al.*,

Figure 3. Forest and grassland area burnt and fire weather (indexed using the Canadian Fire Weather Index, FWI) in the four analysed macroareas during the fire season (May–October) for 2002–2019



Notes: The data are detrended with the first-difference method,[*] and changes are standardized from 0 to 1.[†,‡]

5 EU: France, Greece, Italy, Portugal, Spain; EAST EU: Albania, Croatia, Montenegro, Slovenia; N. AFR: Algeria, Egypt, Libya, Morocco, Tunisia; and M. EAST: Cyprus, Israel, Lebanon, Syrian Arab Republic, Türkiye.

Sources: FWI data provided by: C3S (Copernicus Climate Change Service). 2019. *Climate Data Store: Fire danger indices historical data from the Copernicus Emergency Management Service.* [Accessed on 13 June 2024]. https://doi.org/10.24381/cds.0e89c522

[*] Lobell, D.B. & Field, C.B. 2007. Global scale climate–crop yield relationships and the impacts of recent warming. *Environmental Research Letters*, 2(1): 014002. https://doi.org/10.1088/1748-9326/2/1/014002

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[‡] Ascoli, D. 2023. Incendi e cambiamenti climatici fra record, nuova normalità e adattamento [Fires and climate change between records, new normal and adaptation]. *Sherwood*, 262: 26–29.

2018; Spies, Scheller and Bolte, 2018). A considerable amount of knowledge and many models dealing with fire drivers and fire regimes have been produced for the northern rim of the Mediterranean basin, particularly for the five most affected EU countries, for which long data time series are available. For instance, in the southern European Mediterranean countries, there has been a decreasing trend in burnt areas, which may be partly explained by the increased efforts in fire management and prevention following several large and extreme fires in the 1980s (Spano *et al.*, 2014; Turco *et al.*, 2016). In southern European countries, fire regimes have shifted from fuel-limited to drought-driven due to socioeconomic and land-use changes (e.g. rural exodus to urban areas and subsequent fuel accumulation in the landscape) that favour very large fire events (Pausas and Fernandez-Munoz, 2012). However, in general, fire activity varies greatly from year to year, with changes in fire weather accounting for a significant proportion of the interannual change in burnt area, meaning that firefighting services are more effective when controlling fires in mild weather seasons but experiencing difficulties in extreme weather conditions (Evin, Curt and Eckert, 2018; Tonarelli *et al.*, 2020).

The wildfire issue remains largely overlooked in areas like eastern Europe, North Africa or the Near East (with the exception of Israel and Türkiye). Recently, Curt, Aini and Dupire (2020) pointed out that, despite the numerous similarities between the two rims of the Mediterranean basin in terms of fire regimes, there are relevant contrasting patterns. In North Africa, predominant activities linked to cropland and pastoralism could be limiting the amount of fuel (Chergui *et al.*, 2018), while aridity is increasing rapidly (Benslimane *et al.*, 2008). Fire regimes in these areas may therefore be fuel-limited, and climate slightly less relevant (e.g. Chergui *et al.*, 2018; Curt, Aini and Dupire., 2020). Similarly, Turco *et al.* (2017) highlighted that the interannual variability of summer fire in Israel is related to antecedent wet conditions and their effect on the vegetation, suggesting that in this country burnt area is mainly limited by fuel availability rather than fuel flammability.

Even where the context is limited by fuel availability, burnt area in the Mediterranean is also linked to fire weather (Jones *et al.*, 2022) and, consequently, drier and hotter seasons are favourable to more intense, large-scale wildfires, which are becoming a major environmental, economic and social concern, causing significant economic damages and loss of life. Extreme weather patterns (e.g. extended drought and heat waves, windstorms), and consequently fire weather, facilitate the onset and extreme behaviour of forest fires over large fire-prone areas and challenge the capacities of suppression-centric fire protection programmes, leading to multiple extreme fires interacting for prolonged periods. Future scenarios suggest an exacerbation of the current situation (Jia *et al.*, 2019; UNEP, 2022).

Future fire weather scenarios

Fire weather has been used to estimate fire danger and is represented by different fire weather indices, and it is used for fire danger forecasting by the GWIS via the application Current Situation Viewer.[16] Here, we focus specifically on the Canadian FWI (arguably the most widely applied index in fire-climate research and used by the GWIS) to assess future scenarios of fire weather in the Mediterranean region.

Different global studies have found an overall increase in fire danger and fire activity using different fire weather indices (Flannigan *et al.*, 2013; Abatzoglou, Williams and Barbero, 2019). In Europe, a similar trend of increasing fire weather in already fire-prone southern European countries in the Mediterranean basin was found for future scenarios, as well as an extension of the area where weather conditions will be favourable for wildfire events (Camia, Libertà and San-Miguel-Ayanz, 2017; Galizia *et al.*, 2023).

Although the literature about Mediterranean-specific fire weather projections is limited, in particular for the Near East and North Africa, global and regional studies show an increase in fire weather for the Mediterranean region. In a study focused only on the northern rim of the Mediterranean, Moriondo *et al.* (2006) found an overall increase of FWI values, an extension of the length of the fire season, and an increase of extreme fire weather events, comparing two different climate change scenarios. For the entire Mediterranean basin, Giannakopoulos *et al.* (2009) show an overall increase in FWI values and number of days with extreme values. In their global study, Bedia *et al.* (2015) detected an increase of fire weather for the Mediterranean region specifically for the 2026–2045 period.

FWI projections derived from the latest generation of global climate models (Eyring *et al.*, 2016; Quilcaille *et al.*, 2023) indicate that the entire Mediterranean region will experience some degree of FWI increase during the twenty-first century (Figure 4). The extent of the projected change in FWI differs between the *intermediate* (SSP2-4.5; Figure 4b-c) and *very high* (SSP5-8.5; Figure 4d-e) greenhouse gas emissions scenarios described by the IPCC's Shared Socioeconomic Pathways (SSPs; IPCC, 2023), with the most severe changes associated with the latter. Increases in seasonal mean FWI of up to 30 percent are projected by the middle of the century (Figure 4b-d). The largest increases are projected across the Iberian Peninsula, while notable relative increases are also expected for the Mediterranean ecosystems of France, Greece, Italy and Türkiye. In Spain and southern France, seasonal mean FWI is expected to increase by up to 40 percent by the end of the century under the intermediate scenario (Figure 4c), and by up to 80 percent under the very high scenario (Figure 4e).

In this context of increased fire weather, special attention must be given to those areas where FWI is expected to increase most notably in order to tailor management options, target preventive measures and foresee future restoration needs.

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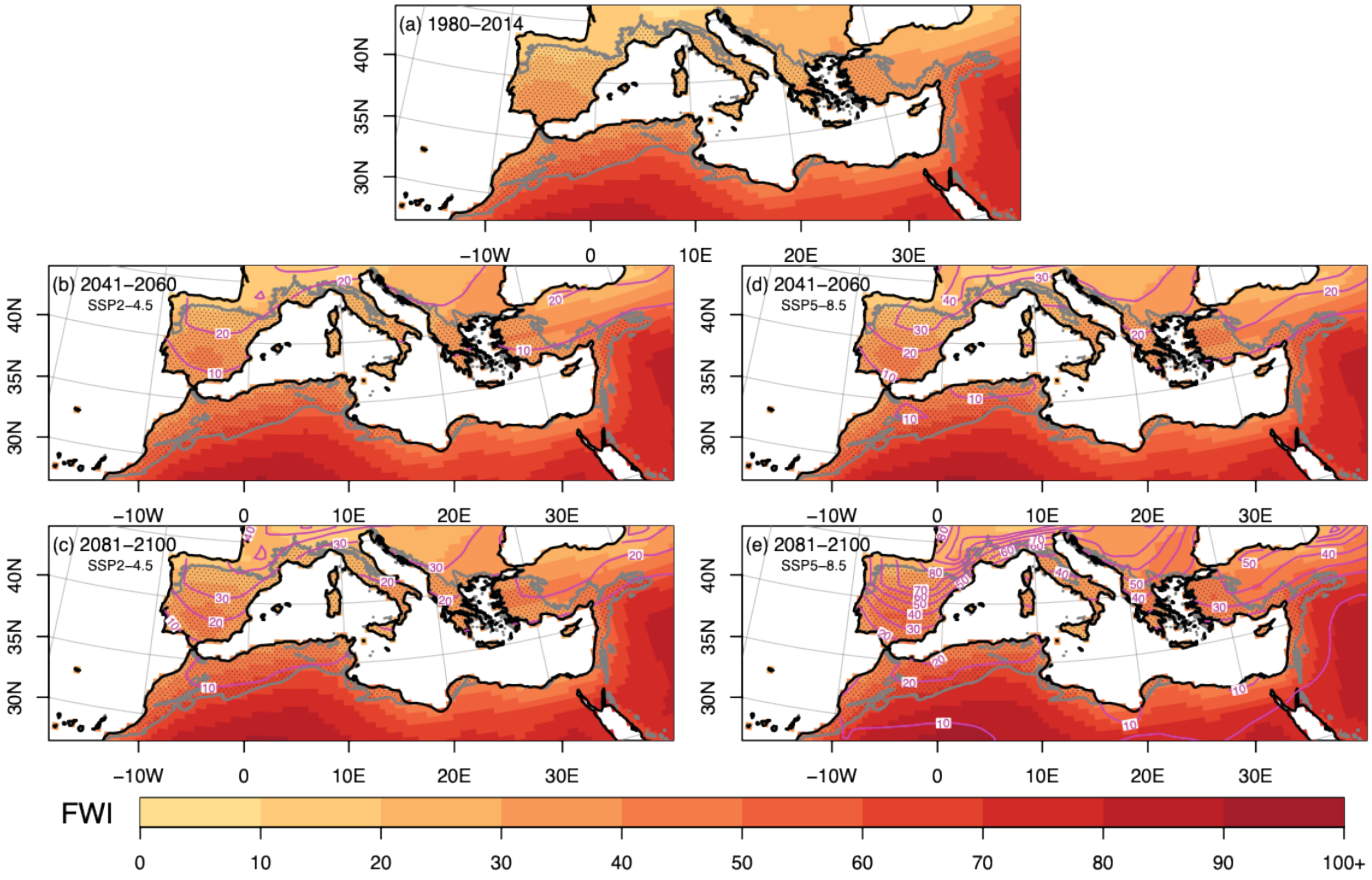
[16] For more information, see https://gwis.jrc.ec.europa.eu/apps/gwis_current_situation/index.html

Figure 4. (a) Historical simulations of the annual maxima in 90-day running mean Fire Weather Index (FWI), averaged for 1980–2014. (b) FWI annual maxima in 90-day running mean under SSP2-4.5 averaged over 2041-2060 and (c) 2081–2100. (d-e) As for (b) and (c) but for SSP5-8.5



Notes: Grey-dotted areas represent Mediterranean ecosystems. Contour lines indicate percentage change in FWI with respect to 1980–2014.

Source: Data from Quilcaille, Y., Batibeniz, F., Ribeiro, A.F.S., Padrón, R.S. & Seneviratne, S.I. 2023. Fire weather index data under historical and shared socioeconomic pathway projections in the 6th phase of the Coupled Model Intercomparison Project from 1850 to 2100. *Earth System Science Data*, 15(5): 2153–2177. https://doi.org/10.5194/essd-15-2153-2023

Implications for future restoration actions

Since the nineteenth century, the traditional strategy in the management of burnt and other devastated forest areas in the Mediterranean basin has been based on establishing forests with coniferous trees (e.g. red pine, Aleppo pine, stone pine) using natural regeneration or reforestation methods (Pausas *et al.*, 2004). This strategy assumed that an initial phase dominated by coniferous tree species as pioneers was required for the restoration of degraded areas and would be followed by the establishment of native deciduous and sclerophyllous species in later stages. This traditional approach has been abandoned since the late decades of the twentieth century due to the changes in fire regimes weakening its effectiveness and very high costs (Pausas *et al.*, 2004).

More recently, new developments in fire and restoration ecology and social demands for the protection and improvement of ecological values have led to new approaches in forest management in general and post-fire restoration in particular (Vallejo, Arianoutsou and Moreira, 2012; Bergmeier *et al.*, 2021). In this context, post-fire restoration should take into account the ecosystem characteristics of the burnt area, possible ecosystem responses to fire impacts, and management objectives (Meyer, Long and Safford, 2021). Depending on the ecosystem affected, each fire has different impacts, and its intensity and severity are under the influence of many different factors like weather conditions and topography (Fernandes *et al.*, 2014). Therefore, in order to carry out well-designed post-fire restoration, detailed knowledge and experience are needed regarding the burnt ecosystems and the effects that the fire may have caused.

The Mediterranean region is currently engaged in several restoration initiatives, both at national and regional level. These include the Agadir Commitment, a joint regional effort endorsed by several Mediterranean countries to restore 8 million ha by 2030. Additionally, in the context of the recently launched United Nations Decade on

Box 1. Post-fire restoration basic principles

1. Restore key ecological processes
2. Consider landscape context
3. Promote regional native biodiversity
4. Sustain diverse ecosystem services
5. Establish a prioritization approach for management interventions
6. Incorporate adaptation to agents of change

Source: Meyer, M.D., Long, J.W. & Safford, H. 2021. *Postfire restoration framework for national forests in California*. Pacific Southwest Research Station General Technical Report PSW-GTR-270. Albany, USA, U.S. Department of Agriculture Forest Service. https://doi.org/10.2737/PSW-GTR-270

Ecosystem Restoration,[17] the Mediterranean region will receive targeted support to capitalize on ongoing post-fire restoration efforts under the coordination of FAO's Committee on Mediterranean Forestry Questions – *Silva Mediterranea* for its implementation.

Some efforts have already been made to identify restoration opportunities in the region, giving priority to certain areas (Martín-Ortega *et al*., 2017). For these restoration initiatives to be successful, the increase in hotter and drier conditions represented in the future fire weather scenarios must be taken into account. While post-disturbance restoration actions are a useful tool for reducing the effects of climate change, traditional restoration approaches based on past reference levels may be inadequate for future situations (Harris *et al*., 2006; Palma and Laurance, 2015).

In order to build more resilient landscapes, restoration projects or strategies should consider restoration objectives and avoid the creation of homogeneous landscapes over large areas (Bergmeier *et al*., 2021), which is especially important in ecosystems dominated by flammable species. The restoration activities should aim for a heterogeneous landscape formed by different vegetation types that will result in different fuel load characteristics. In the decision-making process, it is necessary to consider the level of fire impacts on ecosystems. Generally, natural regeneration and recovery should always be emphasized, but if after assessment, sowing or plantation are still required, local seed sources and seedlings should be prioritized (Sabuncu, Kavgacı and Alan, 2023). In this case, soil preparation for reforestation must be conducted carefully, avoiding activities that may cause soil loss and erosion (Vallejo *et al*., 2012), and ensuring that plant biodiversity is maintained (He, Lamont and Pausas, 2019).

After the fire, burnt areas should be classified at the microbasin level according to fire impacts, restoration opportunities should be assessed according to that classification, and restoration goals and objectives should be set following six basic principles (Box 1) by an interdisciplinary team familiar with the local ecological conditions. The ecosystem–fire relationship is very important, and immediate emergence of dominant plant species in the aftermath of a fire is vital for the rapid recovery of the ecosystem (Arnan, Rodrigo and Retana, 2007).

The need for ecological restoration in the light of the mismatch between severe wildfires and current social systems has drawn attention to opportunities for reintroducing fire as a management tool. Prescribed fire has the potential to reduce fuel and favour fire-adapted landscapes in, for instance, Catalonia, Spain (Alcasena *et al*., 2019) and Provence, France (Prévosto *et al*., 2015). Re-establishment of native broadleaved species can reduce the fuel hazard of exotic pine forests and facilitate the transition to more natural and resilient landscapes (Gavinet, Prévosto and Fernandez, 2016). Revitalizing traditional ecological knowledge about landscape management practices that are on the verge of disappearing, such as burning used by Basque pastoralists, can offer social as well as environmental benefits (Coughlan, 2013). The co-production of science with local and Indigenous Peoples' communities through an interdisciplinary and culturally appropriate approach is important to avoid exploitation of sensitive information, but the potential payoff for coupled cultural and ecological resilience is highly valuable (Ramos, 2022).

Fire is a widely used land management tool, which can help reduce poverty and ensure food security by preserving cultural landscapes and maintaining the ecological integrity and natural biodiversity of many ecosystems worldwide (IUFRO, 2018). Appropriate use of fire can be highly beneficial to communities and help secure the environmental services provided by ecosystems. Fire is still used by rural communities and ancestral Indigenous cultures in traditional livelihood practices for natural resource management, including shifting cultivation, livestock grazing, hunting, management of non-timber species,

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[17] For more information, see https://www.decadeonrestoration.org/

Box 2. A local fire management success story in Sardinia, Italy

Throughout the Mediterranean basin, rural communities have commonly used fire according to traditional knowledge, for landscape and resource management such as pasture renewal.[i,ii] The profound changes in socioeconomic and environmental conditions of the last 50 years have resulted in the partial or total loss of this type of knowledge, partly due to an ageing population, and depopulation in urban and coastal areas. This situation has contributed to an increased fire risk, requiring specific regulations. However, under the influence of the new prolonged fire season and large damaging fires, the traditional use of fire as a land management tool for fire prevention has received increased attention. In addition, new research has highlighted that the integration of landscapes, communities, local knowledge, and socioeconomic and biophysical viewpoints into one holistic vision could strongly contribute to achieving fire-resilient landscapes and fire-adaptive communities.[i]

A case in point is the experience of Suni, a small municipality of about 980 inhabitants with an area of 47 square kilometres, lying on the distinctive basaltic plateau of Planargia (central western Sardinia, Italy). Traditional burning practices aimed at pasture renewal have been maintained but applied at inappropriate periods or underestimating weather conditions. These have resulted in large fires, which required extensive efforts by regional firefighters to be extinguished. Since 2011, the Sardinia Forest Service (CFVA) has therefore been actively engaging with local communities and economic operators to integrate the traditional know-how on fire use in the planning and implementing of fire mitigation measures through prescribed burning and multifunctional activities.[iii] This experiment aims to: (1) address social conflicts related to the use of fire and land in general; (2) train firefighting personnel in the use of fire and tools; (3) control pests; (4) improve the quality and palatability of herbaceous species; and (5) mitigate fire risk. Overall, 60 hectares per season have been treated each year. The networks and collaborations created have led to a decrease in fires from poorly controlled burning, initiating positive change, including in economic terms, when compared to neighbouring municipalities.

Sources: [i] Vázquez-Varela, C., Martínez-Navarro, J.M. & Abad-González, L. 2022. Traditional Fire Knowledge: A Thematic Synthesis Approach. *Fire*, 5: 4. https://doi.org/10.3390/fire5020047

[ii] Montiel, C. & Kraus, D.T. 2010. *Best practices of fire use: prescribed burning and suppression: fire programmes in selected case-study regions in Europe*. Joensuu, Finland, European Forest Institute. https://efi.int/sites/default/files/files/publication-bank/2018/efi_rr24.pdf

[iii] Cabiddu, S., Cuccu, G.M., Pinna, T.M., Casula, A., Magari, L., Putzulu, G., Pala, E.. et. al. 2023. El uso cultural del fuego y sus efectos positivos en regiones agropastorales mediterráneas. *Revista Incendios y Riesgos Naturales*, 10: 35–38. https://revistarirn.org/wp-content/uploads/2023/07/RIyRN-10.pdf

road clearing, cooperative burning to prevent the advance of fire, or fuel reduction, among other things (Bilbao *et. al.*, 2020). There are good examples of these experiences around the world, including in the Mediterranean (e.g. Box 2), showing that integrating local knowledge into fire management strategies is key for the development of mitigation and adaptation strategies under new wildfire dynamics.

Even if burnt areas show a slight decreasing trend overall, over the last few years the intensity and area burnt resulting from single fire events have increased. It is clear that, in a warming climate, the prevalence of fire-conducive conditions in the Mediterranean will be higher, and fires will persist for longer periods. In this challenging situation, management and restoration plans should be developed with consideration of socioeconomic factors, involving the local population and traditional knowledge. Current preventive and restoration efforts should take into account "hotspots", where the intensity of future fire weather is projected to increase, in order to ensure their success.

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In the Ifrane Model Forest, the restoration of the traditional "Agdal" pasture system is particularly effective in increasing biodiversity while improving sheep and goat grazing

The Mediterranean Model Forest Network: involving rural communities in designing restoration projects

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[5] Tlemcen Model Forest, Algeria

The International Model Forest Network: creation, dissemination and founding principles

The year 2022 marked the thirtieth anniversary of the International Model Forest Network (IMFN). The trends and conflicts that

Restoration activities in the Shouf Biosphere Reserve, Lebanon

brought about the IMFN nearly 30 years ago have become increasingly relevant in 2023. Inclusive and shared governance approaches to natural resource management will be even more relevant in building back better for post-COVID-19 green recovery and accelerating action to fight climate change and biodiversity loss.

The Model Forest approach was first developed and implemented by the Government of Canada in the early 1990s on ten sites across the country. It was a response to a period of intense conflict in the Canadian forest sector at a time when environmentalists, governments, Indigenous Peoples, communities and forest workers were at odds about forest resources and how to manage them sustainably. The idea behind the Model Forest concept was to move away from valuing forests for timber alone towards a vision where social, environmental, economic and cultural benefits and trade-offs would be considered equally.

From the beginning, Model Forests promoted the idea of convening stakeholders and forming partnerships under a neutral forum where a range of values and interests could be represented, and where partners could experiment with new ideas under the common goal of sustainable development. Each site was intended to be a dynamic "model" from which others could learn and together, advance their sustainability goals in forests and the larger landscapes that surround them.

The approach showed immediate promise as people came together to find common solutions to the issues that they faced, such as logging practices, biodiversity conservation and economic stability. Bolstered by its success, the Government of Canada announced the development of the IMFN at the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, with the goal of scaling up the lessons learned from Model Forests in Canada and providing a platform to share their experiences with international partners. The IMFN secretariat was officially established in 1995, and today continues to be hosted by the Government of Canada's Canadian Forest Service in Ottawa.

The strength of the IMFN stems from bringing together 60 Model Forests under a broad movement across 35 countries on five continents. No two

Model Forests are the same. While all share six common principles, the cultural, geographic, institutional, political and other circumstances make each Model Forest unique. The activities and approaches undertaken by Model Forests differ in light of this diversity. In some Model Forests, for example, conservation issues are paramount, while in others economic diversification, conflict management, wood value chains, watershed management or other issues are more prominent.

Many land and resource management strategies already reflect some of the core elements of the Model Forest concept — for example, participatory forestry, forest and landscape restoration (FLR), ecosystem-based management, collaborative networks and landscape approaches. However, the following six principles were quite unique back in the 1990s and are still the basis of all Model Forests:

1. Landscape
2. Partnership
3. Commitment to sustainability
4. Governance
5. Programme of activities
6. Knowledge sharing, capacity building and networking

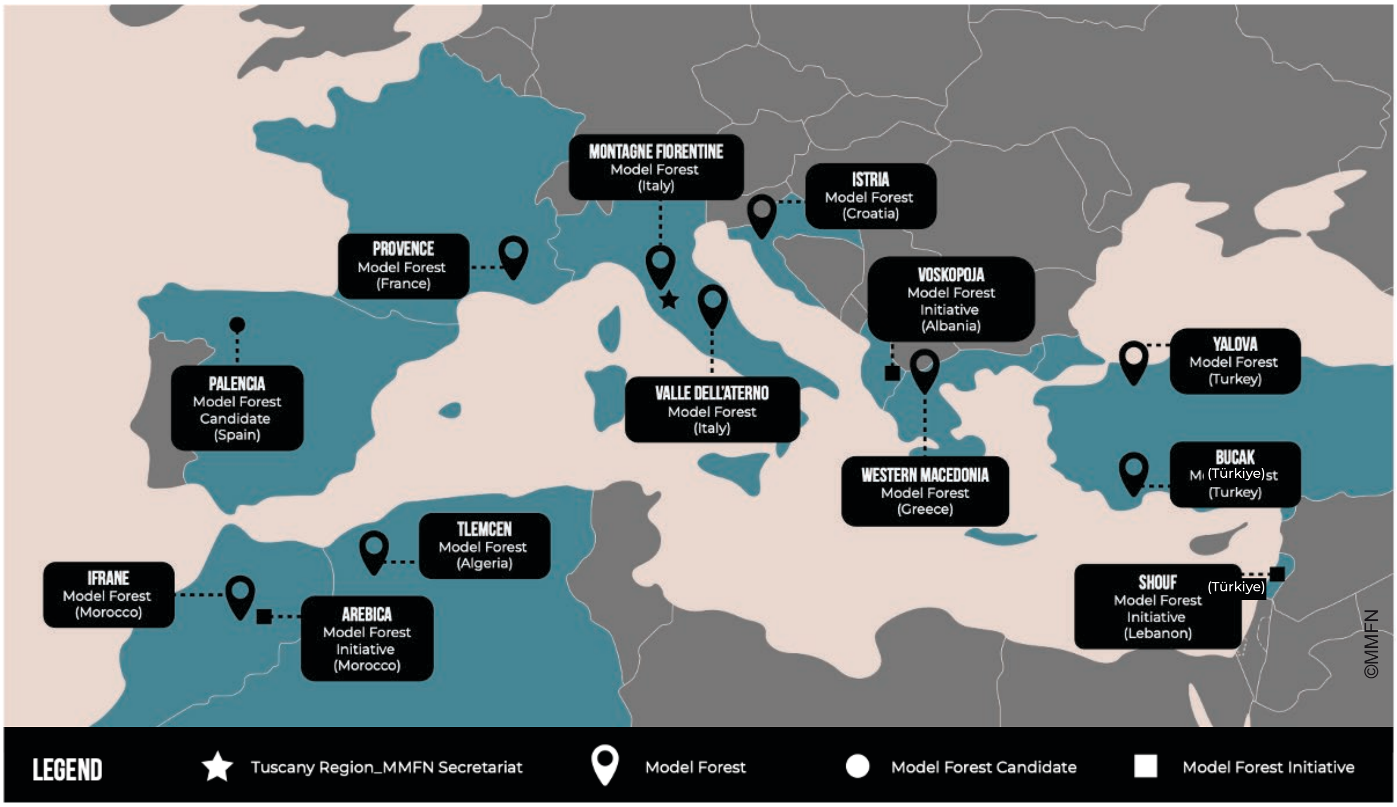
As the international community looks for ways to help forests adapt and remain resilient while achieving their domestic commitments under the Sustainable Development Goals and other agreements, the IMFN is showing sustainability in action, based on flexible landscape and ecosystem management that combines the social, environmental and economic needs of local communities with the long-term sustainability of large landscapes.

Distinctive traits of the Mediterranean Model Forest Network

In 2008, Spain led the creation of the Mediterranean Model Forest Network (MMFN). Since then, the secretariat of the MMFN has been hosted by the Cesefor Foundation on behalf of the Castile and León region. In 2019, the Tuscany region in Italy took over as host to the secretariat with the support of the Union of Municipalities Valdarno and Valdisieve and the Montagne Fiorentine Model Forest Association. The MMFN defines common objectives and promotes collaboration between areas that have similar ecological, economic, social and cultural characteristics while enhancing individual specificities. The regional network cooperates on the development of common priorities, conflict resolution, and the promotion of collaboration on sustainable development in the Mediterranean and beyond.

To date, the MMFN includes ten Model Forests (seven effective and three candidates) plus three recent initiatives seeking to join the network. The effective Model Forests are: Ifrane (Morocco), Yalova (Türkiye), Montagne Fiorentine (Italy), Provence (France), Tlemcen (Algeria), Istria (Croatia) and Bucak (Türkiye). The candidates are

Figure 1. Map of the Mediterranean Model Forest Network


MONTAGNE FIORENTINE
Model Forest
(Italy)
ISTRIA
Model Forest
(Croatia)
PROVENCE
Model Forest
(France)
VOSKOPOJA
Model Forest
Initiative
(Albania)
PALENCIA
Model Forest
Candidate
(Spain)
VALLE DELL'ATERNO
Model Forest
(Italy)
YALOVA
Model Forest
(Turkey)
BUCAK
M (Türkiye) st
(Turkey)
WESTERN MACEDONIA
Model Forest
(Greece)
TLEMCEN
Model Forest
(Algeria)
IFRANE
Model Forest
(Morocco)
AREBICA
Model Forest
Initiative
(Morocco)
SHOUF
Model Forest
Initiative
(Lebanon)
(Türkiye)
©MMFN
LEGEND
★ Tuscany Region_MMFN Secretariat
Model Forest
● Model Forest Candidate
■ Model Forest Initiative

Source: Adapted from MMFN (Mediterranean Model Forest Network). 2024. Mediterranean Network. In: Mediterranean Model Forest Network [map]. [Cited 24 July 2024]. https://www.medmodelforest.net/en/mednetwork/mediterranean-network.html

Palencia (Spain), Western Macedonia (Greece) and Valle dell'Aterno (Italy). Initiatives in Morocco (AREBICA), Albania and Lebanon complete the network.

The development of a network of Model Forests in the Mediterranean region has been and continues to be particularly relevant in view of a number of characteristics and critical issues specific to this area. One prominent factor is the region's dense historical stratification, which has led to great cultural richness thanks to a succession of settlements over the past 3 000 years but has also resulted in multiple conflicts with regard to overlapping interests and competencies in land management at different scales, from the international to the local level.

Another critical element that the Model Forest approach seeks to address is the high vulnerability of Mediterranean lands to the impacts of climate change (e.g. increasing temperatures, extreme rainfall events) which are among the most severe on the planet, with the area recognized as one of the climate change hotspots at global level (Ali *et al.*, 2022).

In this context, the management of ecosystems, landscapes and forests has become more complex, not only because of their environmental variability but also because of the difficulty for governments and international organizations to identify strategies, actions and solutions suited to the economic, social and political circumstances of the various countries in the region. Managers and policymakers need to work on common objectives despite their different starting points, sharing their knowledge and experiences and bearing in mind the need for modularity in design and implementation. They must nurture a long-term vision while recognizing the urgency of planning. Given this complexity, one element remains inalienable and a priority: the fundamental role of local rural communities, and the need to equip them with the actual capacity and skills to plan, set objectives and implement interventions.

The points listed above are just a few among the many assets and challenges of the Mediterranean area. Here the Model Forest approach can provide answers because it helps local communities welcome institutional actors (e.g. various levels of government) and those working in research as "members" of the community itself, who do not "impose" or "teach" but collaborate: a bottom-up process that starts by listening to the needs and knowledge of the region's inhabitants. This way, people can begin to understand the immediate and long-term needs of their area while working to tackle the challenges arising on a national, international and planetary scale.

The Model Forest approach as a best practice in sustainability and restoration governance

At the end of the Seventh Mediterranean Forest Week in 2022, the Model Forest approach was included in the Antalya Declaration as a good practice to be enhanced and expanded to promote the management of Mediterranean forests and landscapes according to a vision in which social, environmental, economic and cultural benefits are equally integrated. In the same way, the Staff Working Document accompanying the EU Forest Strategy in 2013 highlighted how "Model Forests can contribute to supporting sustainable forest management by implementing resource management policies at the local level, establishing networks and ensuring the participation of local communities (EC, 2013, p. 31).

The inclusion of local communities in the management of local areas ensures a more effective implementation of planning and programmatic tools, even and especially in recent years when there has been greater public attention and heightened sensitivity to environmental and climate change issues. The ambitious goals of restoring forest ecosystems and landscapes launched by the United Nations Decade on Ecosystem Restoration 2021–2030 and taken up by the Antalya Declaration need networks with local appeal that can ensure the translation of plans and ideas into concrete actions within a tight time frame and without compromising quality. This is best achieved through existing structures such as local and regional entities equipped with strategic planning capabilities shared between different administrations and stakeholders, including research and academic institutions. Model Forests are an example of this.

Another area where the MMFN has become a benchmark in the Mediterranean concerns youth entrepreneurship and the potential of "nature-based solutions" (NBS) for including the younger generation in the management of forest lands and rural areas in general. How can the younger generation be persuaded to put its energy, resourcefulness and enthusiasm into inhabiting rural areas and working in NBS activities, without this necessarily meaning that they have to embrace an alternative lifestyle or at least a secondary role in the future economy and society? Many opportunities are potentially available through the European Union and other national and international bodies, and multiple projects have been developed over the past few years, including through various funding programmes. Unfortunately, this wealth of opportunities and knowledge often turns out to be poorly accessible and little used given the chronic difficulty of connecting information with those who need it. This is another problem that the Model Forest approach could help solve with its focus on participation and sharing. By raising awareness on the key role of forest and landscape management, the Model Forest approach can create more fertile ground for the emergence of new NBS businesses, bestowing dignity on jobs that are often considered on the fringes or merely occupational as opposed to professional: a pathway that can give new meaning and importance to young people's work in rural areas.

Balancing the needs of those in and connected to the forest sector, whether policymakers, local communities or producers, is essential to reconnect people with the ecosystems in which they live. Model Forests can help make sustainable forest management more

One of the areas burnt by the 2018 wildfire, Calci, Monti Pisani, Italy

"familiar" to people and groups who have access mainly to information superficially processed and delivered by big media outlets and social media. Understanding the difference between forest management and destruction or between using wood and continuing to employ highly energy- and emission-intensive materials, such as plastics, steel and aluminium, requires space to talk without fuelling polarization. The Model Forest approach provides the right forum for having these kinds of discussions, because stakeholders with different views are encouraged to find a common exit strategy where each group's needs are acknowledged, understood and respected.

Actions aimed at restoring ecosystems, forests and landscapes must be perceived and experienced by local communities in rural areas as "their own" and not only as imposed on them by urban environments as is often the case. Only then will the implementation of actions achieve the best possible outcomes, which in turn can trigger new restoration interventions in neighbouring areas (cascade effect) and render the environmental and economic context more attractive, with beneficial social effects and even a counter migration from urban to rural areas.

Case study: forest and landscape restoration after the Monte Pisano forest fire

The fire

In September 2018, a wildfire spread rapidly from a pine forest in the municipality of Calci, Florence, Italy, to the southeastern slopes of the Monte Pisano complex, destroying agricultural as well as wooded areas. The burnt area covered about 1 148 hectares (ha): 1 000 ha of forest and 148 ha of agricultural land. Twelve houses were also partially or completely rendered uninhabitable. The fire extinction and containment took more than four days.

The area affected by the fire featured steep slopes within mountains that reached between 600 metres (m) and 900 m above sea level. The burnt forest was mostly maritime pine interspersed or mixed with broadleaves such as chestnut at higher altitudes, holm oak in lower areas, and water-loving species such as alders and willows near the streams.

Safeguarding interventions

Given the severity of the fire and topographical constraints, the initial interventions focused on safeguarding the slopes to mitigate hydrogeological risk. The area was divided into four zones coinciding with the main catchment areas, and safeguarding interventions were designed and rolled out less than 20 days after the end of the fire. The interventions were carried out in order of priority to fulfil different purposes:

- civil defence, to protect homes and infrastructure;
- protection, to safeguard slopes;
- prevention, to reduce the risk of forest fires in the future; and
- support, to build or adapt infrastructure.

The main interventions included:

- cutting burnt vegetation;
- securing the slopes; and
- restoration, reopening, maintenance and construction of forest roads.

Guidelines for restoration activities

To ensure that the restoration activities were adequately supported scientifically and technically, the Tuscany region established a working group tasked with preparing an official document in the shortest possible time, to be made available to public and private stakeholders interested in participating in the safeguarding and restoration of the ecosystems affected by the fire.

The document covered three main aspects:

- Identifying priority areas and interventions using multiple criteria analysis.
- Defining standard interventions for the functional recovery of the forest environment:
    - » actions to treat burnt plant material;
    - » structural works and re-establishment of vegetation cover to mitigate the risk of erosion and hydrogeological disruption;
    - » interventions to support the natural recovery of forest and pre-fire habitats; and
    - » preventive interventions to strengthen forest resilience.
- Planning for systematic monitoring.

A LiDAR survey of the entire area covered by the fire was also carried out to obtain recent digital models (a digital terrain model and a digital surface model) to allow for detailed analysis of the areas impacted by the fire and surrounding areas, detect the main geomorphological criticalities, and better position the most challenging structural interventions.

A complete revision of the Monti Pisani forest firefighting prevention plan (known as the AIB plan) was also conducted. The plan serves as an effective prevention tool against forest fires, identifying strategic management areas and actions, such as firebreaks, AIB service roads, prescribed burning and asset protection zones, to limit the intensity, severity and extension of future fires. It also contains a cost–benefit analysis of preventive actions, which is essential in areas such as this one with an extensive urban–forest interface.

The Monti Pisani Forest Community

The fire has instilled a deep sense of the risks associated with forest fires and of the susceptibility and vulnerability of the forest stands among the residents of Calci, where more than 60 percent of the municipal land was affected by the event. This renewed awareness has led to a surge of interest in the forest among many residents wanting to get involved. Following a thorough participatory process assisted by local public bodies, the Monti Pisani Forest Community was created.

The community fosters growth and stability in the area by helping promote civil defence and improve knowledge in this regard. It helps disseminate information on the planning options and guidelines of the local authority; brings together a varied range of stakeholders and encourages information exchange among them; promotes projects for active management of the forest through its technical commissions; facilitates collaboration among the local network of volunteers; and supports local production and tourism.

Another outcome was the establishment of the first two firefighting communities in Tuscany (municipalities of Calci and Vicopisano). These communities are usually created at the initiative of the municipality by a group of residents who live in isolated or small clusters of houses within the forest. Through a participatory process with the local authority, the residents suggest silvicultural interventions that could be carried out to create buffers around forest fuels and asset protection zones around their homes. For these initiatives to be successful, it is important that the municipality and the residents are actively and directly involved in the implementation and day-to-day management of the activities, so that the burden of risk mitigation can be shared among public actors and private individuals.

Forest vegetation restoration and management interventions

Building on previous material, data and collaborations, in 2020, the Tuscany regional authority defined the priority areas for carrying out interventions for the restoration and management of forest vegetation. The main focus was to create more fire-resilient forests through:

- completion and integration of safeguarding interventions;
- management of burnt material, including through salvage logging;
- soil and stand improvement and protection interventions;
- seeding and planting; and
- maintenance of existing infrastructures.

Case study: the first conservation initiative for the Egyptian vulture *Neophron percnopterus* in the Tlemcen National Park, Northwest Algeria

Introduction

The Egyptian vulture *Neophron percnopterus* is one of six vulture species endangered or critically endangered in Africa (AWF, 2024). There are three recognized subspecies of the

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One of the Egyptian vultures of the existing pair in the Tlemcen National Park photographed by members of the Tlemcen Model Forest during the project surveys

Egyptian vulture worldwide. The *Neophron percnopterus percnopterus* subspecies is found in southern Europe, Central Asia, the Near East, Africa and Northwest India (Mishra *et al.*, 2018). It has been recorded in Algeria, where it is endangered but where its distribution is not well known. At the national level, the species is protected by Executive Decree No. 12-235 of 24 May 2012, which lists protected species of non-domesticated animals. All birds of prey are protected under this executive order.

The Tlemcen Model Forest (TMF) works closely with the park as its landscape approach covers all land uses including wildlife conservation. In relation to the Egyptian vulture, the TMF members are conducting activities within the park to achieve the following objectives:

- act urgently to halt the extinction of the only existing vulture pair in the Tlemcen National Park;
- estimate the Egyptian vulture population in the Tlemcen province;
- encourage the colonization of potential sites for the species by promoting the survival of the existing pair in the Tlemcen National Park; and
- contribute to the conservation and growth of the Egyptian vulture population in the region by conducting studies to improve our understanding of the species.

To achieve these objectives, the conservation and restoration of ecosystems that are key for the reproduction and survival of the species are essential. But to better plan and guide the actions required, it is important to gather more information about the behaviour and ethology of the Egyptian vulture.

Data collection and dissemination

To collect the information needed to develop an effective ecosystem restoration plan to conserve the Egyptian vulture, the TMF carried out surveys and found that there was only one remaining breeding pair of Egyptian vultures in the Tlemcen National Park. Photographic traps were placed in and around the nest to monitor reproduction and collect data on egg-laying, incubation, reproduction success, feeding and behaviour of the young. The information and data gathered were also useful for raising awareness of vultures among the residents living close to the park, tourists and park visitors, using pictures and videos, and sharing knowledge about their important role in the Tlemcen ecosystem.

Conclusion and outlook

The conservation and restoration of biogeographical zones and vulture populations are important objectives in several countries to promote the protection and restoration of biodiversity at the local, regional, national and international levels. Other sectoral policies are relevant to these birds, whose benefits are increasingly taken into consideration, including potential economic benefits from ecosystem services linked to biodiversity. The TMF has received funding from the United Nations Development Programme (UNDP) to continue its work on Algerian vultures. National tours coordinated by the Directorate General of Forests in collaboration with Algeria's national parks and biosphere reserves, and environmental associations, have been organized to raise awareness of the value of vultures and the services that they provide. Meanwhile field surveys have also been carried out to continue the work of identifying vulture populations and monitoring their status.

Next steps towards forest and landscape restoration in the Mediterranean basin

Every year, the MMFN increases the efforts that it puts into FLR projects, recognizing the value of the Model Forest approach and its governance tools for achieving restoration objectives while integrating environmental, social and economic perspectives. Its takes its cue from the IMFN strategy of the Government of Canada, which has just launched its Global Forest Leadership Program. Within this programme, the IMFN has launched the initiative IMFN Climate: Scaling Up Nature-Based Leadership Platforms for Climate Resilience, Restoring Degraded Forest Landscapes and Biodiversity. Through this initiative, it will assist Model Forests in at least ten countries eligible for official development assistance (ODA) via CAD 18.4 million in contribution funding in 2023–2026. The target objectives will include place-based investments in NBS through FLR, strengthened gender equity in sustainable forest and land management, and knowledge for development in forest and natural resource management education.

To apply for these funds, the MMFN has listed projects to be developed in and with the ODA countries that are part of the network, namely Algeria, Lebanon and Morocco, while strengthening the sharing of relationships and experiences with the other Model Forests. Efforts will be made to improve the secretariat's capacity to involve and include the Model Forests of ODA countries in the activities and opportunities of the network, through a broad communication campaign aiming to engage with local communities, including in Arabic and other widespread languages in the region, such as French and Spanish. A monitoring platform, based on remote sensing data and field surveys will be developed by the MMFN to check the progress of the Model Forest surface areas in connection with the Agadir Commitment target to restore at least 8 million ha of degraded forest ecosystems by 2030. The platform will be tested and calibrated through demonstration sites in the ODA countries of the network and will also act as a decision-support system. It will support the monitoring of the commitment goals and help identify the priority spots for the next FLR activities, considering local and global climatic, social and economic factors and needs. Through other projects of the IMFN Climate and the Canadian Global Forest Leadership Program, the MMFN will work on organizing exchange visits between the Model Forests of the network to empower local representatives and managers. The sharing of experiences and best practices will focus on environmental and forest education, with particular attention to inclusion, equity and social justice.

The MMFN's efforts will continue to focus on enhancing the role of local communities in FLR in their respective areas. Inclusive and participatory approaches like that of the Model Forests are key to the success of FLR projects as they place people's lives, culture and needs at the centre of intervention design. In this way projects stand a better chance of producing lasting results.

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Status and priorities of the younger generations in the Mediterranean forest sector

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An overview of Mediterranean youth

Regional sociodemographic facts

The population in the Mediterranean region was approximately 548 million in 2022 (World Bank, 2024) spread across 19 countries in southern Europe and in North Africa and the Near East (NENA).[18]

Most of the region's population lives in southern and eastern Mediterranean countries, including North African and Near Eastern countries. These countries have experienced a major demographic transition in the last 70 years, going from 72 million residents in 1950 to 334 million in 2022 (Blöss-Widmer, 2022).[19] This is quite different from the southern European countries along the sea's northern shores, whose population has increased from 158 million in 1950 to 226 million in the same period (Blöss-Widmer, 2022).[20]

Young people between the ages of 15 and 29 represent the largest age group in the Mediterranean basin, with some notable differences among countries. Overall, people under 30 years of age were 248 million in 2020, out of which 178 million, or 72 percent, lived in North African and Near Eastern countries. The proportion of people under 30 in these countries was 53 percent. Conversely, only 69 million people under 30 years of age lived

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[18] The countries of the Mediterranean region considered in this article are the 20 following member countries of the Committee on Mediterranean Forestry Questions – Silva Mediterranea: Albania, Algeria, Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Libya, Malta, Morocco, Portugal, Saudi Arabia, Slovenia, Spain, the Syrian Arab Republic, Tunisia and Türkiye.

[19] Blöss-Widmer (2022) focused on Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, the Syrian Arab Republic, Tunisia and Türkiye.

[20] Blöss-Widmer (2022) also included countries within the Balkans to provide these figures, considering Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, France, Greece, Israel, Italy, Malta, Montenegro, North Macedonia, Portugal, Serbia, Slovenia and Spain.

Table 1. Definition of youth by country

Country	Age range	Definition	Official document(s) and public institution
Greece	15–29	"National policy issues in the field of youth concern areas of activity and government initiatives, which respond to the interests and serious issues that exclusively concern young citizens, with a target group of young people aged 15 to 29, which must be addressed by the State as separate and apart from the issues that fall within the scope of formal education and training at all levels".[i]	The Strategic Plan for Vocational Education Training, Lifelong Learning and Youth 2022–2024, issued by the Hellenic Ministry of Education and Religious Affairs
Malta	13–30	Since 2010, the Malta National Youth Policy has considered youth to include those between the ages of 13 and 30.[ii]	National Youth Policy, Ministry for Education, Sport, Youth, Research and Innovation
Spain	16–29	According to the Spanish Youth Guarantee Plus Plan (GJ+) 2021–2027, youth are those between the ages of 16 and 29.	Resolution of 24 June 2021, approving the Youth Guarantee Plus Plan 2021–2027 for decent work for young people, Ministry of Labour and Social Economy
Morocco	15–29	In Morocco, the Ministry of Youth, Culture and Communication defines young people as persons between the ages of 15 and 29, since the first national youth consultation held in 2001.[iii]	Promoting Opportunities and Participation for Young People, Ministry of Youth, Culture and Communication
Cyprus	14–35	"The National Youth Strategy of Cyprus, which is the main policy document on youth policy in Cyprus, clearly defines the lower and higher age limit of the young population it targets as 14-35 years old. The National Strategy on the sexual and reproductive health of young people defines youth differently, targeting only youth between 15-29 years old. However, the most adopted age range addressed in the field is 14-35, as defined by the Youth Board of Cyprus, the National Agency for Youth. The National Youth Strategy does not identify any specific subgroups within the main youth age group".[iv]	National Youth Strategy of Cyprus (2017–2022), Youth Board of Cyprus
Portugal	Approx. 15–29	"Youth is a difficult concept to define, as it is the phase of the life cycle that marks the transition from childhood dependence to adult independence, in which a successful emancipation process is essential for the autonomy of young people. This period of transition to adulthood has been subject to various social transformations – demographic, economic and cultural, among others – and is characterized by relativity, depending on the context. For this reason, it is possible to find in the legal and political framework a plurality of age ceilings (maximum age of access) in youth policy measures or in the definition of intervals for processing statistical data, such as: 30 years in the case of the Cartão Jovem (Youth Card); 24 years for youth unemployment statistics; 35 years for the Porta 65-Jovem renting programme; and 40 years in the definition of young farmer."[v]	II National Youth Plan 2022–2024 (IIPNJ), Portuguese Institute for Youth and Sports (IPDJ)
Tunisia	15–29	Tunisia often considers youth to be those between the ages of 15 and 29. This definition is based on the practice of many Tunisian public institutions, including the Ministry of Youth, Sport and Professional Integration. However, it does not have a general scope or absolute legal value in the country.[vi]	*None*
Jordan	12–30	"In Jordan, 'youth' is defined by the National Youth Strategy 2019–2025 as the age group between 12 and 30 years covering a period of 19 years. (...) The Ministry of Youth identifies three subgroups to provide targeted programmes for different age cohorts: 12–17 years, 19–23 years and 24–30 years."[vii]	The National Youth Policy (2019–2025), Ministry of Youth and Sports

Country	Age range	Definition	Official document(s) and public institution
Türkiye	14–29	"Youth is a concept that should be discussed in a sociological rather than just biological sense. (…) When the conditions of our country are taken into account, individuals between the ages of 14 and 29 are accepted as the target group of youth policies."[viii]	The National Youth and Sports Policy Document (2013), Ministry of Youth and Sports
France	Approx. 15–30	There is no single administrative definition of "youth" in France. Without having strictly defined limits, youth policies generally concern those under 30 years of age.[ii] The definition of youth categories varies according to the sources and the needs of the surveys: 15–29 years, 18–24 years, 10–29 years, 18–34 years, and so on.[ix]	Key figures for youth 2021, National Institute for Youth and Popular Education (INJEP)
Lebanon	15–29	"Youth in Lebanon are the category of people aged between 15 and 29. It was so defined by the Lebanese Ministry of Youth and Sports, and the United Nations agencies working with children and youth, youth associations in the Lebanese civil society, and experts, based on social and economic characteristics specific of Lebanon".[x]	National Youth Policy 2012 and National Youth Policy Action Plan 2022, Ministry of Youth and Sports

Sources:

[i] Hellenic Ministry of Education and Religious Affairs of Greece. 2022. *The Strategic Plan for Vocational Education Training, Lifelong Learning and Youth 2022–2024*. Athens. https://www.minedu.gov.gr/publications/docs2020/%CE%A3%CF%84%CF%81%CE%B1%CF%84%CE%B7%CE%B3%CE%B9%CE%BA%CF%8C_%CE%A3%CF%87%CE%AD%CE%B4%CE%B9%CE%BF_EEK%CE%94%CE%92%CE%9C_%CF%80%CF%81%CE%BF%CF%82_%CE%95%CF%80%CE%B9%CF%84%CF%81%CE%BF%CF%80%CE%AE_%CE%92%CE%BF%CF%85%CE%BB%CE%AE%CF%82.pdf

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[viii] Ministry of Youth and Sports of Türkiye. 2013. *The National Youth and Sports Policy Document*. Ankara. https://gsb.gov.tr/dosyalar/mevzuatlar/TheNationalYouthandSportsPolicyDocument(1).pdf

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[x] Ministry of Youth and Sports of Lebanon. 2012. *Youth Policy in Lebanon endorsed on 3 April 2012*. http://www.minijes.gov.lb/getattachment/Ministry/YouthPolicy/Youth-Politics-in-Lebanon/Youth-Policy-in-Lebanon(English).pdf

in southern European countries in 2020, which represents a 26 percent drop in 40 years. This means that in the southern and eastern regions, the number of people under 30 years almost doubled over the same period, while it decreased in the countries along the sea's northern shores (Blöss-Widmer, 2022).

In countries such as Egypt and Lebanon, young people range from 30 percent to 40 percent of the population, a proportion that is trending upwards. However, in northern Mediterranean countries (such as France, Italy, Portugal and Spain), this age group accounts for about 15 percent to 18 percent of the total population, and over the last three decades, the youth population has decreased (IECD, 2019).

Who is considered a young person?

There is no generally accepted definition globally of the ages marking the beginning and end of youth. The definition of youth depends on cultural perceptions, which influence social and economic norms, trends and laws in each country. The legal status of young people, and therefore the age ranges for youth also vary within each country, considering factors such as marriage, the right to vote and land rights (ILO, 2005).

For instance, the National Youth Policy of Türkiye considers any person between the ages of 14 and 29 to be a young person (Ministry of Youth and Sports of Türkiye, 2013), whereas in Jordan, a young person is between 12 and 30 years of age, according to the National Youth Strategy 2019–2025 (Ministry of Youth of Jordan, 2019).

Some countries have no fixed definition of youth, such as the Syrian Arab Republic and Tunisia, for example. Having no national definition of youth can create barriers and issues for countries. Defining youth at the national level establishes a clearly recognizable group at which specific public policies can be targeted (along with rights or protection measures, for example) (OECD, 2021a). It is also important to note that intersectionally,[21] many identities and different dimensions of diversity will always occur (e.g. young women, rural youth, disabled youth, Indigenous youth) within each national setting, making it inaccurate to speak of "youth" as a homogeneous group.

Given the lack of a universal definition, FAO aligns with the United Nations, which defines youth as persons between the ages of 15 and 24 years for the purpose of statistical consistency across countries and regions. However, this does not fully cover the period of transition into adult working life, which is key to the concept of youth. Therefore, the definition of youth tends to be broadened (O'Higgins, 2017) to include all those between the ages of 15 and 30 years, as in the case of this article.

Youth as a group defined by transitions

Youth is a particular target group that is defined by an age bracket and represents a transitional period. As opposed to other groups targeted by global development interventions, such as women or Indigenous Peoples, everybody is young once in their lifetime. To better understand the challenges, opportunities and needs of youth, it is important to understand the different transitions and changes that define this period.

The transition to adulthood can be determined by three different transitions according to the International Labour Organization (ILO): the personal, educational and school-to-work transitions. These are highly interrelated and have important consequences for future pathways or trajectories (Chacaltana, Elder and Lee, 2020).

Table 2. Rates of unemployment, youth unemployment and young people not in education, employment or training in selected Mediterranean countries

Country	Unemployment rate	Youth unemployment rate	NEET rate
Cyprus	6.8	18.6	13.8*
Egypt	7.4*	17.6*	28.7*
France	7.3	17.3	11.5*
Greece	12.4	31.4	11.3
Israel	4.8*	7.7*	16.8*
Italy	8.1	23.7	19.8
Jordan	19.8*	43.7*	32.9*
Malta	2.9	8.3	13.5*
Morocco	12.3*	31.8*	n.a.
Portugal	6	19	7.6*
Spain	12.9	29.8	11*

Notes: Data are from 2022. Data from 2021 are marked with an asterisk (*).

All data used are as last reported by the country.

n.a.: not available

Source: ILO. 2023. *ILOSTAT*. [Accessed on 20 June 2024]. https://ilostat.ilo.org/data/

- **The personal transition** stands for when individuals start taking on responsibilities as adults – including by making decisions on civil status and reproduction – and when they may stop being dependent and become heads of households or parents.
- **The educational transition** can be a major driver of young people's career and personal trajectories. There are three main groups: those who are studying, those who have already achieved the level of education they aspire to, and those who have dropped out of education.
- **The transition to work** is when most young people enter the labour market after studying at any level. Entry may not be easy in a labour market with high levels of unemployment and informality. The distribution of quality jobs is biased against young people,, particularly in a first job. In general, what young people have achieved in the education system is a key determinant of their future careers. This transition to working life can represent a phase of economic instability.

In developed and developing countries alike, many socioeconomic factors affect the transition into adult working life, including discrimination and social disadvantage as well as cyclical and structural trends in the economy. This transition is also influenced by factors such as the average age of completion of education and initial training, and the average age at which young people are expected to adopt adult roles in the community (ILO, 2005).

In Mediterranean countries, youth face pressing issues. A delayed transition into adulthood is common in Mediterranean societies, causing a prolonged youth age model. Despite being in their mid-thirties, many young people fail to achieve key milestones considered typical of adulthood, including a job, financial stability and living independently, getting married and having children. This delayed entry of youth into the labour market is often the reason within the region for continuing to extend the age brackets to include more people in key policy areas, such as employment, housing and social protection (Perovic, 2016).

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[21] Intersectionality is a term first coined by Kimberle Crenshaw, which showcases how the combination of multiple forms of inequality or disadvantage can create obstacles that often are not perceived nor understood among conventional ways of thinking (Crenshaw, 1989). It represents overlapping or interdependent systems of discrimination related to age, disabilities, ethnicity, gender, geographic location, sex, socioeconomic status or sexuality for example. https://genderedinnovations.stanford.edu/terms/intersectionality.html

Youth employment in the Mediterranean and the potential of the forest sector

The general challenge of youth employment in the region

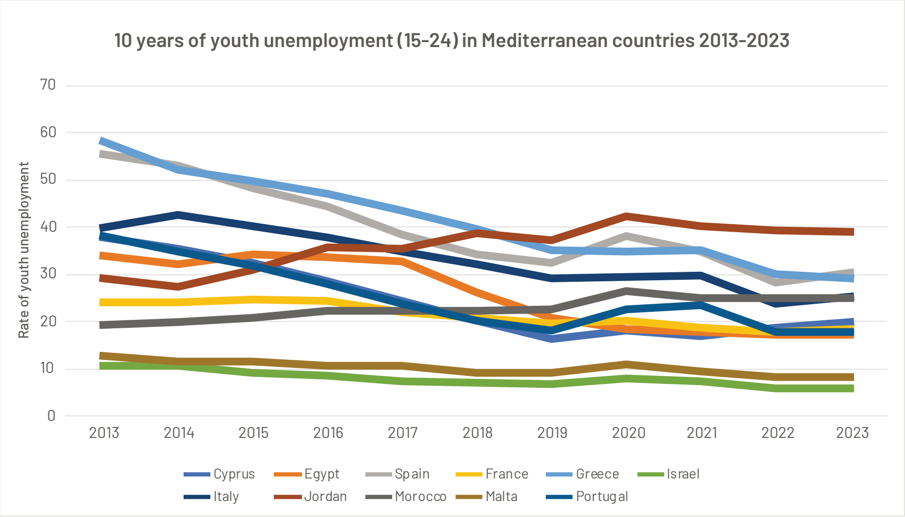
According to the ILO Global Employment Trends for Youth 2022, worldwide, the youth unemployment rate (for 15-to-24-year-olds) was estimated at 15.6 percent in 2021, which is more than three times the adult rate. In most Mediterranean countries, youth unemployment rates are higher than the global average, both within and outside the European Union (IECD, 2019; Table 2).

Young workers are twice as likely as adult workers to live in extreme poverty and are also far more likely to be informally employed. The COVID-19 crisis exacerbated the labour market challenges that young people face and disrupted the quality and quantity of education and training (ILO, 2022). This is also the case in Mediterranean countries, where the rates of youth unemployment and youth who are not in education, employment or training (NEET) are high.

In North African and Near Eastern countries, young women face higher rates of unemployment and are more likely to be in a NEET situation than young men. For example, in Egypt, in 2021, the youth unemployment rate was 12.9 percent for young men and 42.5 percent for young women. Similarly, in Jordan, the youth unemployment rate for young men was 41.9 percent in 2021, compared to 55.4 percent for young women.

Youth unemployment in the Mediterranean has remained high in the past decade (2013–2023), at above 15 percent for most countries. Trends vary among countries. In 2013, while 58.1 percent of active youth aged between 15 and 24 years of age in Greece were unemployed, this figure had dropped to 29.2 percent in 2023. Jordan experienced the opposite trend. In 2013, 29.2 percent of youth were unemployed, a proportion increasing to 39.1 percent in 2023.

Figure 1. Rate of youth unemployment (15-to-24-year-old group) from 2013 to 2023 in Mediterranean countries



Note: All data used are based on ILO modelled estimates up to November 2022.

Source: ILO. 2023. ILOSTAT. [Accessed on 20 June 2024]. https://ilostat.ilo.org/data/

The complexity of youth unemployment in the Mediterranean

Mediterranean youth face several socioeconomic challenges, where difficult access to education, training or employment makes it hard for young people to integrate socially and in their community, affecting their autonomy.

The school-to-work transition can be particularly challenging in southern Mediterranean countries, showing that education does not guarantee employment (Albinyana and Martinez, 2022). High NEET rates in the region reflect low-skilled youth as well as high rates of skill mismatch, including university graduates who cannot find work opportunities (Eichhorst and Neder, 2014). Such challenges are further accentuated by gender.

A persistent problem in Mediterranean countries, and the forest sector, is the polarization of the labour market between formal/informal and permanent/fixed-term contracts. Permanent contracts are characterized by dismissal protection, whereas the fixed-term ones do not necessarily include it. The transition to a permanent employment position can be delayed and complicated by the fact that such positions are more costly for the employer (Eichhorst and Neder, 2014).

The barriers to youth employment have long-term consequences and lead to impacts on society as a whole at economic, social and political levels (Albinyana and Martinez, 2022). Unemployment and exclusion in southern Mediterranean countries can also lead to youth radicalization[22] (OECD, 2021b). Tough labour market conditions are one of the most relevant pull factors for migration flows to countries with better labour prospects.

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[22] Youth radicalization occurs when young individuals adopt extreme ideologies or beliefs, often resulting in actions that challenge established norms or authorities. Several factors contribute to this phenomenon, including environmental influences, structural violence, coercion, poverty, education, familial and peer dynamics, political ideologies and cultural traditions (Özerdem and Podder, 2011). Youth unemployment means a lack of job opportunities or the inability for young people to secure employment. The absence of opportunities can heighten feelings of alienation, frustration and disillusionment with societal frameworks, potentially making individuals more susceptible to radicalization. These dynamics intersect particularly in contexts where disenchanted youth, grappling with limited economic prospects, become more susceptible to extremist narratives or recruitment endeavours (Adelaja and George, 2020).

Government responses to youth unemployment in the Mediterranean

Young people are directly and indirectly concerned by government regulations. Indirectly, their access to public services and opportunities in education and employment is shaped by legal frameworks, which also directly impact their relationship and participation with government and public institutions (Denstad, 2009).

The high rates of youth unemployment in Mediterranean countries reflect structural issues in areas that facilitate access to the labour market, such as education, training and decent work opportunities. To overcome these issues, countries can benefit from policies and interventions focused on youth, such as national youth policies, national employment policies (NEPs) and youth employment strategies.

Overall, few Mediterranean countries have a comprehensive national youth policy or youth employment strategy. However, they have increasingly included youth employment objectives in their NEPs and in their national development plans. Some have also adopted youth employment action plans and technical and vocational education and training strategies, and active labour market policies targeting youth. There has therefore been an increase in the adoption of policies, practices and programmes to support young people's access to the labour market. Such strategies require cost funding and coordination via an interministerial body (Arancibia, 2016).

EU member countries have committed to the Youth Guarantee (EC, 2023), which aims to ensure that those under 30 receive quality job offers, continuing education, apprenticeships and traineeships. Following this commitment adopted in 2013, countries have developed implementation plans to kick-start their response to youth unemployment, establishing timelines for youth employment reforms and measures, roles for public authorities and other organizations, and funding for such activities.

Other countries, such as Türkiye, have adopted more youth-focused policies at the national level. In 2013, Türkiye adopted a national youth policy led by the Ministry of Youth and Sport and a specific national youth employment strategy and action plans for 2014–2023 led by the Ministry of Labour and Social Security and the General Directorate of Labour, thereby introducing a wide range of policies, strategies and interministerial and intersectoral collaboration focusing on young people and youth employment (ILO, 2023).

North African and Near Eastern countries do not have a regional commitment like the Youth Guarantee but have increasingly adopted national youth strategies. These tend to cover employment and other key dimensions, including education, and civic and political participation. In addition, national youth strategies have been developed but not formally adopted in Egypt and the Syrian Arab Republic (ILO and UNICEF, 2023). Therefore, countries in the whole region have progressively adopted youth laws, and national youth policies or strategies.

Youth employment and green jobs in the forest sector in the Mediterranean region

Gaps in information and data

Forests and the forest sector are a source of employment, livelihoods and incomes in the Mediterranean, covering a wide range of activities. However, studies on forest-related employment are scarce, and trends remain unclear globally. There is an information gap between developed and developing countries. Even when data are available, the main challenge is comparability due to methodological differences. The quantification of forest-related employment is complicated by the lack of agreed-on definitions, different data-collection methods, and the fact that not all countries report information (Lippe *et al.*, 2022).

Globally, employment in the forest sector is characterized by being male dominated, with high rates of informality and seasonality (Owuor *et al.*, 2021) – which increases the challenges of capturing the full extent of the forest-related workforce (ILO, FAO and Thünen Institute of Forestry, 2022). Youth, as a disaggregated group, and particularly youth employment in the forest sector, are even more difficult to capture. Young people – often lacking experience – are more likely to access informal and temporary jobs. The formal employment contributions of the forest sector may also be underestimated, as there has been a decline in traditional forestry operations and workers, but also an increase in occupations related to ecosystem management and recreation due to higher demand for environmental goods and services. Therefore, the number of jobs that the forest sector provides may be larger than estimated (UNECE and FAO, 2018).

Understanding the current workforce in forestry and the sector's future needs is a key policy area that could drive change, according to the UNECE/FAO/Forest Europe Guidelines on the Promotion of Green Jobs in Forestry. The sustainability and resilience of the forest sector depend on evidence-based policies and response strategies. These are formulated based on reliable and comparable forest-related employment statistics on a national and global scale. The socioeconomic benefits of forests could be enhanced by employment statistics that are of good quality and consistent (Lippe *et al.*, 2022).

The availability and representativeness of data can be improved by stakeholder cooperation. The UNECE guidelines propose both the use of modelling techniques and consultation and dialogue mechanisms to do so. The first considers productivity, age, gender and skills in workforce projections. The second involves relevant stakeholders and provides a mapping of labour market needs. This combination can enhance the development of green jobs and human resources plans (UNECE and FAO, 2020).

Decent green jobs for young people in the forest sector

As a key sector contributing to the transition to a green economy and hence, to sustainable development, forests will continue to provide direct and indirect job opportunities in the changing world of work (ILO, 2019).

The green economy and green policy packages provide not only a potential generator of decent employment opportunities for young people but also contribute to sustainable and inclusive structural transformation and economic diversification (ILO, 2022).

According to UNECE, forest and forestry related activities can be grouped into seven main and overlapping thematic areas containing different types of green forest jobs[23] (Table 3). Green jobs have been a feature of the forest sector for a long time (traditional), have recently emerged (newly established), or potentially open new fields of work (future) within these seven forest and forestry related activities. There are 19 fields of activity altogether (Fagan *et al.*, 2022). These cover wood products, non-wood forest products (NWFPs) and sociocultural activities provided by forests.

Adapting education and developing young people's green skills for green jobs in forestry

Establishing a favourable environment for green jobs in the forest sector implies government regulations and changes in legal and policy frameworks. Youth policies, including rural youth employment and youth engagement strategies in forestry initiatives, as well as green policy packages, are essential to foster a favourable environment for green jobs (UNECE and FAO, 2018)

These must be accompanied by new skills and education frameworks that address the forest labour market's requirement for adaptation, covering innovation, research, rural and urban connection, monitoring,

Table 3. Thematic areas and fields of activity for future green jobs in the forest sector

7 thematic areas	19 fields of activity in the forest sector
Wood and energy production	Wood production Energy production
Agroforestry and mountain forestry	Agroforestry Mountain forestry and soil bioengineering
Social and urban development	Urban forestry and arboriculture Culture and forests
Forest management, inventory and planning	Forest inventory and forest monitoring Planning, governance, sustainable forest management Pests, disease and forest fires Risk management and contingency planning
Biodiversity and ecosystem functioning	Biodiversity conservation and nature protection Climate change Forests and water Mycoforestry*
Health and recreation	Forest ecotherapy Recreation, leisure and sports
Education and research	Education, further training and knowledge transfer Forest research
	Other new fields of activity

Note: * Fungi cultivation within forest agriculture.

Source: UNECE & FAO. 2018. *Green jobs in the forest sector*. Geneva timber and forest discussion paper 71. Geneva and Rome. https://unece.org/DAM/timber/publications/DP71_WEB.pdf

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[23] A green forest job is a "job that complies with the principles of sustainable forest management, contributes to the transition to a green economy, and involves the manufacture of forest products or the performance of forest services, or both" (Fagan et al., 2022).

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World Food Forum Flagship 2023 side-event "Branching Out: Youth Action and Entrepreneurship in Agroforestry for Economic and Environmental Impact", co-organized between the Mediterranean Youth Taskforce and The International Forestry Strudents Association

gender diversity and recruitment strategies (FAO and UNECE, 2019). Promoting access to quality skills development, training opportunities and skills certification through education and vocational training is key for improving the working conditions and employability of youth and forest workers and for increasing the attractiveness of the sector to young people (ILO, 2019). The future of sustainable forest landscapes includes youth engagement and participation (Fagan *et al.*, 2022).

Youth engagement and participation in the Mediterranean forest sector

Participation in decision-making processes is another key issue for Mediterranean youth involved in the forest sector. According to the Organisation for Economic Co-operation and Development's (OECD) Youth Stocktaking Report, there is a need to bridge the "governance gap" for youth engagement and empowerment in public and economic life. The report stresses that "governance matters and that governments and non-governmental youth stakeholders need to think and act 'youth' to translate political commitments into youth-responsive programmes, initiatives and services" (OECD, 2018).

At the regional and global level, young people's participation has increased in recent years, as they have been attending global gatherings on climate change to express their concerns and press governments to act. However, they are often denied participation or given little access in decision-making processes where their perspectives and ideas could be integrated towards more effective policies. The participatory mechanisms available may not always enable them to make meaningful contributions to these processes (UN, 2010).

The global forest policy fora are no exception. There is much information and research on the role of a wide range of public- and private-sector actors in this context, including environmental non-governmental organizations, government authorities and scientific communities. However, youth participation in global forest policy processes has not been explored enough.

Even if some youth organizations in European Mediterranean countries are able to participate through national platforms for stakeholder involvement in the development of forest policies and decision-making processes (Forest Europe, 2020), this is not the case everywhere.

Analysing the perception of youth delegates on their participation in international forest-related conferences, a study by Yunita, Soraya and Maryudi (2018) found that, paradoxically, even though youth felt that their participation was valued, they also feared that their views and ideas on forest challenges were not considered enough and that opportunities to express them were limited. The young people insisted that forest-related international conferences should provide more opportunities to facilitate engagement with other groups, and to discuss and share solutions (Yunita, Soraya and Maryudi, 2018).

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Florence Lacrosse, youth representative, at the opening ceremony of the Seventh Mediterranean Forest Week

Joining efforts towards a regional voice for Mediterranean youth in the forest sector

Young people are increasingly engaging in efforts not only to promote sustainable forest management and biodiversity conservation in the region but also to reinforce youth participation, employment and overall opportunities in this sector.

In 2017, through the Agadir Commitment (FAO, 2017), ten Mediterranean countries[24] pledged to restore 8 million hectares of degraded forest ecosystems by 2030. In 2022, during the Seventh Mediterranean Forest Week (MFW) in Antalya, Türkiye, Chadi Mohanna, Director of Rural Development and Natural Resources at the Ministry of Agriculture of Lebanon, and Co-chair of the Committee on Mediterranean Forestry Questions – *Silva Mediterranea* ("*Silva Mediterranea*"), highlighted that this goal could

Food and Agriculture Organization of the United Nations
REPUBLIC OF TÜRKIYE MINISTRY OF AGRICULTURE AND FORESTRY
GENERAL DIRECTORATE OF FORESTRY
MEDITERRANEAN YOUTH DIALOGUE
22nd March 2022
7th MFW
7th MEDITERRANEAN FOREST WEEK
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Youth representatives (Leila Rossa Mouawad and Florence Lacrosse) at the Seventh Mediterranean Forest Week present the main outcomes of the Mediterranean Youth Dialogue

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[24] Algeria, France, Islamic Republic of Iran, Israel, Lebanon, Morocco, Portugal, Spain, Tunisia and Türkiye.

The Mediterranean Youth Taskforce from its inception to its first board

The Mediterranean Youth Taskforce (MYTF) is a network of young members who are actively engaged in the Mediterranean region's forest sector. The MYTF aims to create an inclusive space for capacity building, knowledge sharing and youth empowerment, with the goal of contributing to the inclusion and engagement of young people in Mediterranean forestry issues. The MYTF envisions a future where young people can participate and contribute to decision-making processes and policy dialogues. To achieve this vision, it proposes, leads and carries through innovative actions in the Mediterranean forest sector.

The MYTF's key priorities include capacity building, cultural exchange, knowledge sharing, and youth empowerment and participation. The MYTF is governed by a direction board, which consists of various coordinators responsible for the overall functioning of the taskforce, including through communication, partnerships, events, and financial and scientific committees. The committees work collaboratively to achieve the MYTF's objectives and promote meaningful youth engagement in the Mediterranean region's forest sector.

The MYTF follows a theory of change that involves producing quarterly reports outlining the impact and results of its activities and interventions, with a focus on transparency, equality, inclusivity, collaboration and commitment as core values.

only be achieved through the direct participation of youth (World Forest Voices, 2022).

Efforts are being made to find a unified regional voice that reflects the challenges and opportunities that exist for young people in the forest sector.

At the Seventh MFW, young people from across the region participated in a Youth Dialogue. They discussed the challenges that they faced in the forest sector and proceeded to identify key needs, highlight inspiring experiences and propose recommendations. The outcomes of the dialogue were summarized in a Youth Statement (*Silva Mediterranea*, 2022) gathering the key challenges and recommendations under five thematic areas:

1. Inclusive participatory and decision-making processes at all levels.
2. Economic and financial resources and opportunities.
3. Education programmes and capacity-building and training opportunities for youth in forestry.
4. Mediterranean youth across the rural–urban divide.
5. Communication and transparency on forestry issues.

Overall, the young people acknowledged the collaborative nature of their recommendations and called upon all actors and sectors to improve communication, coordination and collaboration among each other to support youth in unlocking their potential in the forest sector (Rivera Lima and Mosier-Giovine, 2022).

The outcomes and conclusions of the dialogue and statement were presented at the high-level segment of the Seventh MFW, where they were heard by *Silva Mediterranea* and regional decision-makers, as shown in the photo below (Mouawad and Lacrosse, 2022). The dialogue and statement also fed into the regional youth consultations of the XV World Forestry Congress and its "Work with us – Youth Call for Action" (FAO, 2022).

The Mediterranean Youth Taskforce (MYTF) was created to achieve this unified perspective of improving the forest sector and creating a better future for youth.

At the regional level, young people are increasingly recognizing the importance of the forest sector for the environment and the economy. Conversely, they are also increasingly being recognized as key actors that play a pivotal role within the sector. Initiatives such as the creation of a regional youth taskforce backed by the *Silva Mediterranea* secretariat and the European Forest Institute's Mediterranean Facility (EFIMED) are helping connect young professionals, researchers, policymakers and practitioners keen to make Mediterranean forests more resilient.

Country focus on youth-led and youth-engaging initiatives on restoration: the case of Lebanon

The Biodiversity Conservation Initiative

Mediterranean youth engage in existing initiatives but also lead their own. In 2022, a group of young enthusiasts launched the Biodiversity Conservation Initiative (BCI) of the Saint Joseph University of Beirut to help conserve Lebanon's rich biodiversity and achieve the country's 50 percent conservation target by 2030. The BCI brings together young experts in research, innovation, conservation, botany, management and communication and serves as a hub providing scientific evidence to improve conservation, the integrity of protected areas and resilience to global change across a variety of ecosystems.

BCI contributed to the launch of the first complete online national biodiversity database covering fauna, flora and fungi.[i] It also led the way in seed storage, the development of species-specific germination protocols, genetic characterization, and providing genetic material for species recovery programmes to overcome genetic bottlenecks and genetic drifts.

Additionally, BCI is part of the LIFEPLAN consortium.[ii] The LIFEPLAN project aims to study the current status of biodiversity around the world. Local experimental stations have been set up in different plots to study the biodiversity of Lebanon. BCI has also drafted a law for a new category of protected areas in the country: plant microreserves, whose goal is the conservation of a single species.

The highlight of BCI's work is ecological restoration. DNA metabarcoding methods were used to evaluate the plants consumed by 15 mammal species native to Lebanon based on their scats in the Horsh Ehden Nature Reserve. This work served to understand plant-mammal interactions. More than 133 plant species from 54 different families were detected and identified. Understanding the animals' dietary plant components will be highly valuable for selecting species in upcoming reforestation projects.

With years of experience in preserving genetic diversity, ecosystem restoration, and *ex situ* and *in situ* conservation of critically endangered plants, BCI is blazing a trail for younger researchers and practitioners to follow.

Sources: [i] Lebanon Biodiversity. 2023. *Lebanon flora, fauna and fungi*. [Accessed on 21 June 2024]. http://www.lebanon-biodiversity.org/

[ii] University of Helsinki. 2023. *Lifeplan: A Planetary Inventory of Life*. [Accessed on 21 June 2024]. https://www.helsinki.fi/en/projects/lifeplan

The Youth Conservation Corps and the Lebanon Reforestation Initiative

The Youth Conservation Corps is a youth employment programme created by the U.S. Department of Agriculture Forest Service, and in Lebanon, it is implemented by the Lebanon Reforestation Initiative. It seeks to address unemployment and the need for conservation work. Its purpose is to train eligible youth in educational, social and vocational skills while they assist in the conservation of natural resources and contribute value to local communities. In Lebanon, the 6-month programme was first implemented in 2021, targeting youth aged 18 to 24 years. Selected among the most economically vulnerable with an equal gender distribution, the young people are trained to develop their educational, social and vocational skills, which helps them map out a career path and improve their future job prospects while conserving the country's natural resources and helping local communities. The young people work on public lands and protected areas and develop an ethic of environmental stewardship and civic responsibility. They participate in outdoor projects such as building and repairing trails, removing invasive species, managing existing forests and planting new ones, helping with wildlife and land research, supporting fire prevention activities and awareness-raising, and leading on environmental education. This programme extends within and beyond the Mediterranean region.

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Members of the Mediterranean Youth Taskforce at the Mediterranean Network Forum 2022 held in Barcelona, Spain

Way forward and recommendations

Young people in the Mediterranean region face complex socioeconomic hurdles transitioning into adulthood. This is reflected by the different age brackets between and even within countries when defining who is a young person. **National definitions of youth** are key for designing, introducing and applying public policies that target and benefit youth despite the group's diversity.

Youth definitions also contribute to better **data collection** on this group, not only at the national level but also for reference and comparability at the regional and global levels. They also facilitate further data disaggregation, which allows the consideration of different areas, such as education and employment, and different economic sectors, including the forest sector. Even if forests and the forest sector are a key source of jobs, livelihoods and incomes for millions of people worldwide, quantifying and estimating the forest-related workforce at the national and global level remains challenging.

For some countries, employment in the forest sector, for instance, is approximately calculated as the sum of employment in other sectors or subsectors (such as agriculture and manufacturing). This makes it difficult to get an accurate picture of forest-related employment at the national, regional and global levels.

The availability, reliability and representativeness of **data on forest-related employment** can be improved by stakeholder cooperation. There is a need for forest-related employment statistics on a national and global scale, which could also be disaggregated by gender and age. Agreed-on definitions and data-collection methods are an important step towards better understanding the forest sector and the roles of different groups, such as youth, within it. Comparability would be made easier if more countries reported information, helping get better regional outlooks.

Understanding the forest sector's **formal and informal workforce through quantitative and qualitative data** also provides insights into the situation and potential opportunities available for young people.

As a key area of the **green economy and sustainable development,** forests and forestry-related activities provide a wide range of **green job** opportunities for young people. Promoting access to updated education frameworks, training opportunities and skills certification through technical and vocational education and training adapted to the needs of the forest labour market, is key for improving the working conditions and employability of youth and forest workers and for increasing the attractiveness of the sector to young people.

Green policy packages towards the green economy that include education and employment measures within the forest sector are a potential generator of decent employment opportunities for young people and contribute to sustainable and inclusive structural transformation and economic diversification. Without government regulations and updated legal and policy frameworks, it is difficult to establish a favourable environment for green jobs and decent employment for youth and the general population in the forest sector.

Youth engagement and participation is also a key aspect for the future and sustainability of the forest sector. There is a lack of data, information and academic research on young people's engagement and participation within the forest sector, in particular in national, regional and global forest policy processes.

Engaging youth opens the opportunity for consultation to better understand the complex reality of a specific generation and population, which then allows for more accurately targeted policies and action plans.

As young people's issues are increasingly being highlighted, and youth can be considered a target group for many different initiatives, **the word "youth" risks being used as a buzzword and youth engagement activities risk tokenization** (where young people are only called to be present or participate to tick a box but without being properly heard or included). To avoid this happening, young people should be increasingly included and allowed to take part in decision-making processes, where their knowledge, perspectives and ideas could be integrated, leading to more effective policies and decisions.

In the Mediterranean forest sector, employment and participation are two of the main interlinked priorities of the region's youth. Transforming political commitments into youth-responsive programmes, initiatives and services implies understanding and therefore involving young people.

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Olfa Nouri, a 32-year-old agrientrepreneur in Khacheb, Beja, Tunisia

Regenerating the arid Mediterranean: women's resourcefulness leads the fight against climate change

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Current research indicates that drylands in the Mediterranean have been expanding over the past few decades and are projected to continue to grow due to a more pronounced warming effect than in other regions (Zeng *et al.*, 2021). The intensification of human activities such as overgrazing coupled with population growth have resulted in 30 percent of semi-arid Mediterranean drylands now being affected by desertification. Since 1961, 8.3 million hectares (ha) of arable land have been lost in the Mediterranean because of land degradation (FAO, 2020). This has primarily been driven by land abandonment, unsustainable exploitation of natural resources, and uncontrolled economic and industrial development (Halbac-Cotoara-Zamfir *et al.*, 2020). The expansion of Mediterranean drylands and desertification underscores the critical role of long-standing silvopastoral systems in mitigating environmental challenges such as drought, soil erosion and limited water resources in the region. Silvopastoral systems integrate the cultivation of trees with livestock farming and typically incorporate pastures featuring widely spaced or clustered trees throughout the grazing area (Grebner *et al.*, 2021).

The resilience and adaptive capabilities of women play a key role in combating land degradation, since they hold skills and develop practices, rooted in traditional knowledge, that can be sustainable, efficient and cost-effective in improving land quality and reversing the effects of a changing climate.

For instance, in Algeria and Tunisia, women are tackling desertification by recycling date palm residues and converting them into an organic treatment to improve soil properties and fertility, harnessing traditional methods of production and the principles of a circular economy (Green Mediterranean, 2022). Moreover, in the Governorate of Zaghouan, Tunisia, women are developing the agroforestry potential of the area by continuing to grow olive trees (*Olea europaea*), carob trees (*Ceratonia siliqua*) and aromatic plants. Women collect and harvest various plants, including rosemary (*Rosmarinus officinalis*), lentisk (*Pistacia lentiscus*) and pennyroyal (*Mentha* sp.), and a women-led community-based organization uses a modern distiller to process the raw materials harvested to produce floral water and essential oils, thereby enhancing the livelihoods and resilience of the community (Haddad, Herrera and Besbes, 2022).

In the Mediterranean, as in other parts of the world, women face significant barriers and challenges, including insecurity regarding land tenure, and access to credit and technology, which hinders sustainable land management.

Women are less likely to be included in decision-making and governance institutions in rural areas. This exclusion is particularly pronounced in the realm of public politics, where societal expectations and traditional gender roles can limit women's participation. Moreover, in the Near East and North Africa (NENA) region, women often face more precarious situations than men due to outdated policies and cultural norms that perceive women as homemakers, limiting the full exercise of their rights and capacities over farms.

Dunia El Khoury, founder of the Women's Agricultural Development Association (WADA), at the WADA centre in Deir el Ahmar, Lebanon

© FAO/Dunia El Khoury

The rural workforce in the Mediterranean region shows distinct gender patterns. In southern Europe, there is a trend known as the *masculinization of rural populations*, where women often move to urban areas for better opportunities, leaving farms mainly to their male siblings. In contrast, the NENA region is seeing a *feminization of agriculture*, with women increasingly taking over the management of herds and farms as young men seek opportunities abroad (Baruah and Najjar 2022; Stanley, 2015). These gendered trends significantly impact land management and restoration efforts.

Women manage land and water resources, and are essential to dryland development, and frequently serve as the primary financial providers for their families. Women are key agents of change for resilient drylands, especially if properly equipped, as they can play a fundamental role in strengthening both livelihoods and ecosystems (UNCCD, 2017).

The masculinization of rural populations in the Mediterranean

The rural workforce in the Mediterranean region is deeply influenced by gender norms, which shape the roles and visibility of men and women in the agricultural sector. The industrialization and mechanization of agriculture in Mediterranean rural systems have led to a gradual exclusion and invisibility of women in forestry and agropastoral management (Sabaté Martínez, 2018). Historically, women's knowledge and practices were integral to these systems, especially in southern Europe and the Iberian Peninsula. However, the gender division of labour has become more distinct over time. Men are associated with commodified agricultural, livestock and forestry tasks, while women take on domestic roles or act as secondary supports for the men's work without clear recognition (neither legal nor practical) of their actual role in production tasks and responsibilities (Silibrandi and Zuluaga, 2014). In 2018, women represented only 24 percent of farming labour in Spain (Sabaté Martínez, 2018), while men accounted for 68 percent of the agricultural workforce in Portugal (Sabater, 2020).

Currently, women play critical roles on farms often owned and led by their male relatives without clear recognition of their actual labour status. In Portugal, women still face discrimination regarding land ownership. Similarly, in Greece, which has one of the largest agricultural workforces in the European Union, entrenched gender inequality resulted in women owning only 23 percent of farms in 2010 (Sabater, 2020).

Moreover, while women have been driving rural and agrarian economic diversification through activities such as agritourism and food transformation, only a fraction of long-term

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Focus group discussion with Syrian women farmers in a refugee camp in Balamand, Lebanon

employment positions created by development and multistakeholder programmes were occupied by women. This division deepened with agricultural industrialization, further marginalizing women in terms of land access and decision-making spaces (Carretero and Avello, 2011). For example, only 9 percent of agricultural cooperatives in Andalusia, Spain, have equal representation of men and women, with most in the region composed solely of men (Hernández Ortiz *et al.*, 2018). To revert this trend, Spain has enacted the Law of Shared Ownership (Ley 25/2011, 2011), which acknowledges women's contribution to farming and asserts their right to land access and fair compensation for agricultural work. Nevertheless, as of 2017, only 339 women throughout Spain had requested and obtained the acknowledgement of shared ownership (Senra Rodríguez, 2018).

The current phenomenon of masculinization of rural spaces is increased by women's decisions to leave or migrate, often because of the lack and inadequacy of services, social pressure, perception of risk and limited opportunities. "In some rural areas of Mediterranean countries (southern Italy, Spain, Greece), women have frequently to search for remunerated job opportunities in urban areas" (EC, 2008), and in other countries, they are forced to migrate abroad.

In addition, women from urban areas are reluctant to marry rural men, farmers or herders, or to settle in small, traditional and often isolated communities where opportunities are fewer and where they may be unable to continue their own professional careers (Fernández-Giménez, Ravera and Oteros-Rozas, 2022).

The ways in which some women, whether local or newcomers, develop strategies to overcome barriers and occupy a diverse role in the different dimensions of agriculture and silvopastoral systems, remain underexplored (Fernández-Giménez, Ravera and Oteros-Rozas, 2022).

The feminization of agriculture

The feminization of agriculture refers to the increasing participation and responsibility of women in agricultural activities, as they take control of herds and farms while young men seek better economic and life opportunities in other countries (Baruah and Najjar, 2022; Stanley, 2015). This shift results in a growing proportion of women involved in agricultural work. However, the term "feminization of agriculture" often carries a negative connotation, implying that agricultural work is undesirable (Slavchevska Kaaria and Taivalmaa, 2016).

While it is true that in many developing nations, agricultural productivity may contribute less to the economy compared to other industries and often involves lower wages, it is important to recognize that not all agricultural employment yields poor returns (Slavchevska, Kaaria and Taivalmaa, 2016). The term "feminization" is valuable as it denotes a process of change crucial for analyzing the

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A farmer cultivating a crop of corn in Ain Draham, Tunisia

evolving dynamics of women's roles in agriculture.

In certain cases, this feminization can lead to female empowerment, particularly when successful migration and remittances, combined with access to credit and technologies, enhance agricultural outputs. Conversely, in unsuccessful scenarios, women face increased workloads and financial hardship, leading to disempowerment (Slavchevska, Kaaria and Taivalmaa, 2016)

In the NENA region, the gender gap is the second widest globally, as reported by the World Economic Forum's 2022–2023 Annual Report (WEF, 2023). Women's full participation in agricultural and silvopastoral systems is influenced by a complex interplay of factors, including migration patterns, gender disparities and socioeconomic constraints. Men in the region often prefer male involvement in key decisions, and women's signatures are sometimes deemed untrustworthy in business contracts (Chien *et al.*, 2023). The division of labour remains entrenched, with men responsible for land preparation and planting, tasks perceived as less time-consuming and better paid. Additionally, women have more limited access to resources such as land, credit, technology, and knowledge of new practices. Data from Algeria, Egypt, Lebanon, Morocco and Tunisia show that due to social norms, the share of female agricultural landholders remains lower than 7.1 percent (FAO, 2023). When women do inherit land, they often rent it out or partner with male farmers for cultivation (Chien *et al.*, 2023). Women in the NENA region have limited access to information on agricultural practices and techniques, marketing and trading, and often rely on second-hand information from male family members (Chien *et al.*, 2023).

Despite these challenges, women play a crucial, multifaceted role in agriculture and silvopastoral systems in the NENA region. They engage in various activities such as weeding, harvesting, food processing and animal husbandry. Women's knowledge about the use of medicines, herbs and aromatic plants is essential for the preservation of dryland agrobiodiversity (Abdelali-Martini and Dey de Pryck, 2015). Their involvement in silvopastoralism, which integrates trees, pasture and livestock, is vital for sustainable land management and biodiversity conservation, highlighting the need for more inclusive policies to support women's contributions in this sector.

These gender-divided roles partly explain the feminization of agriculture. For instance, when the Syrian Arab Republic embarked on an agricultural intensification programme in 1975, the number of women involved in agricultural work rose from 31.7 percent in 1980 to 60.7 percent in 2010. This increase was due to the mechanization of tasks that were previously almost exclusively male-dominated, while the need for planting, weeding, harvesting vegetables and legumes, and tending to small livestock remained stable or even increased (Abdelali-Martini and Dey de Pryck, J. 2015).

This shift in gendered roles in agriculture can also be attributed to other factors such as male off-farm employment, economic globalization, and the outward migration of men (Abdelali-Martini and Dey de Pryck, 2015). In some cases, women are increasingly taking on roles traditionally held by men in agriculture, such as leading agricultural businesses, albeit often without holding legal rights over land and titled farms. Moreover, female workers often operate under informal, verbal agreements that lack job security or social benefits and frequently work in inadequate or unsafe conditions (Abdelali-Martin and Dey de Pryck, 2015).

Within prevailing gender norms, women's earnings are often considered "supplementary", resulting in minimal empowerment for women. This underscores that the feminization of agriculture has not been accompanied by significant transformative change in female empowerment, as women are not entitled to the same legal rights or decision-making powers.

Often, when men migrate to other areas, poorer households are more likely to experience labour feminization because they cannot afford external male labour to replace the absent men. Conversely, women may be discouraged from taking over men's responsibilities to avoid potential conflicts upon the men's return (Baada, Antabe and Sano, 2021).

Overall, in the Mediterranean, gender dynamics and women's empowerment are complex and influenced by socioeconomic factors, cultural norms and regional differences that have a direct impact on land management. Targeted policies are essential to address these elements for sustainable land restoration and the socioeconomic empowerment of women.

The following case studies demonstrate how women across the Mediterranean have led collective actions challenging agricultural rural masculinization in southern Europe and societal biases that limit access to land, credit, technologies and representation in the NENA region.

Gender responsive approaches and best practices in rehabilitating silvopastoral lands in the Mediterranean region: the examples of Spain and Lebanon

Over the past 60 years, transformations in rural systems have shaped the gender landscape of forestry, agropastoral management and the agricultural labour force in Spain. Currently, men dominate the agricultural labour force, comprising 76 percent of it. Despite efforts to promote gender equality, including the Spanish Law of Shared Ownership (Ley 25/2011, 2011) and legal frameworks such as Organic Law 3/2007 (Ley Orgánica 3/2007, 2007) and Law 45/2000, these measures have not significantly shifted the gender balance in decision-making positions. An overwhelming 78 percent of governing councils consist solely of men, highlighting the low participation of women in decision-making roles (Hernández Ortiz *et al.*, 2018).

The impact of social media on silvopastoral governance

Despite the historical invisibility of women's roles in the management of natural resources in the Iberian Peninsula, as evidenced by the scarcity of academic literature on women in the governance of silvopastoral systems, women in Spain are increasingly taking on significant roles, especially among younger generations. A major catalyst for this transformation is the rise of social media. Digital platforms provide virtual spaces that foster autonomy, mutual aid and empowerment, ultimately enhancing women's confidence and facilitating their participation in public arenas.

The Asociación de Corcheros y Arrieros de Andalucía (ACOAN), representing cork harvesters and extractors who work with mules in Andalusia, Spain, established in 2017, exemplifies this shift. This organization, continuing a long-standing regional tradition, brings together workers from Cádiz and Málaga, including women who actively demand labour rights, salary improvements and better working conditions (Pérez and Quintero Morón, 2019).

This women-led movement utilizes digital social networks like WhatsApp and Facebook to share information, mobilize participants, and champion pro-environmentalist and pro-feminist discourses. These online spaces are becoming crucial in reshaping the governance of silvopastoral systems, providing new discourses and challenging traditional gender roles.

Intergenerational sorority in Spanish pastoralist women: Ganaderas en Red

The Spanish Network of Women Livestock Farmers, Ganaderas en Red, exemplifies a transformative movement among pastoralist and extensive livestock-rearing women in Spain. This dynamic women-only association unites traditional and newcomer pastoralists of all ages, hailing from both urban and rural settings, into a cohesive and supportive network. Utilizing mobile apps for efficient decision-making, the network fosters communication and collaboration.

Ganaderas en Red is dedicated to elevating the visibility of women in extensive livestock enterprises. It establishes a robust knowledge network where seasoned pastoralists mentor newcomers, thereby perpetuating their cultural and professional legacy. This network effectively advocates for their rights and lifestyle through strategic lobbying efforts. (Ganaderas in Red, 2024).

The network's success is anchored in its commitment to assembly-based decision-making, professional facilitation, conflict resolution, and a strong culture of solidarity. By harnessing these principles, Ganaderas en Red not only enhances the professional landscape for women livestock farmers but also ensures a sustainable and inclusive future for pastoralism in Spain.

Transforming the landscape: the role of women in Spanish pastoralism

Another driving force behind the evolving landscape is the idealization of rural life as a rejection of fast-paced capitalism, partly fuelled by social media. The Catalonia region of Spain, in particular, has witnessed a surge in young women embracing shepherding and pastoralism as part of the "new peasantry". These women, often city-born and well-educated, have been inspired to move to the countryside by adopting degrowth and agroecological principles. The School of Shepherds has also played a significant role in the education and motivation of these young women, who now participate in the women pastoralist regional network of Ramaderes de Catalunya. (Fernández-Giménez and Ravera Oteros-Rozas, 2022).

Breaking down barriers of participation and empowerment, these young women are actively involved in innovative silvopastoral management initiatives aimed at sustainable farming and environmental restoration. Projects such as grazing the forest margins in the Collserola Natural Park, where shepherds receive direct economic payments for biomass removal, are notable examples. Furthermore, their involvement in the Ramats de Foc alliance, supported by both private and public entities, facilitates forest grazing to prevent wildfires while addressing land access challenges for young pastoralists. Many of these women also collaborate with the Artisanal Butchers Guild of Girona, which enhances the value of their products by certifying their origin from herds that reduce wildfire risk (Fernández-Giménez and Ravera Oteros-Rozas, 2022).

Despite historical gender disparities, the intersection of social media and changing perceptions of rural life is paving the way for women to play increasingly vital roles in Spain's agricultural sector. These women are challenging traditional norms and contributing to sustainable practices, thereby reshaping the future of pastoralism in Spain.

Women's collective actions for sustainable rural development in Lebanon

Established in 1991, the Women's Association of Deir El Amar (WADA) is a local organization led by women residents in the rural area of Deri El Ahmar in the Bekaa Valley and has played a key role in including women in decision-making spaces for rural development and land restoration. Despite the challenges posed by long-standing conflict and the impacts of climate change, such as drought, WADA is leading initiatives focused on inclusive community consultation to start collectively designing the first local development plan.

Restoring local land and livelihoods

WADA is empowering women to lead land restoration efforts in Deir El Amar, Bekaa Valley. Women from ten villages are collaborating through informal consultations to tackle the region's main challenges: summer water scarcity, overuse of natural resources, youth migration, lack of innovative agricultural technology, and rising agricultural costs. These consultations have built their capacities and earned them community and public recognition for their proactive approach.

From 1991 to 2023, WADA has been acknowledged for raising awareness and responsibility for land restoration and rural development, emphasizing heritage and environmental protection. The organization has also boosted local tourism by encouraging families to open guesthouses. With WADA's support, Lebanese women established an educational garden showcasing Bekaa Valley's biodiversity, including thousands of trees and medicinal plants. They implemented an innovative drip irrigation system, ensuring plant survival in water-scarce areas.

WADA's strategies promote sustainable agricultural growth and income while preserving the environment. Capacity-building initiatives have improved women farmers' access to better products, services and knowledge, enhancing their entrepreneurial skills in product marketing and rural tourism. These initiatives foster sustainable agriculture through environmentally friendly practices, technologies and services, particularly focusing on ethnic products like jams, syrups, vinegars, pickles, distillations and herbal teas. All plants are organically grown and harvested by local farmers.

WADA's innovative approach integrates tourism with sustainable agriculture, engaging women and youth in the sector. By highlighting the area's rich historical and natural heritage, the initiative aims to uplift the community's self-image. WADA also collaborates with women to safeguard traditional products and slow rural exodus, involving more women in sustainable livelihood activities that help restore degraded lands. Women's incomes have increased through producing rural food and craft products, supported by the Lebanese Agriculture Research Institute (LARI), which provides access to traditional seeds for crop diversification and silvopastoral activities.

The empowerment of women in WADA demonstrates their effective collaboration for community benefit. United with a clear objective, these women are significantly impacting climate change and fostering meaningful change at local and national levels. The resilient local population has long faced climatic adversities, prompting WADA to develop strategies to mitigate these challenges and bolster community resilience. Central to these efforts is the empowerment of rural women, whose crucial role in driving local development initiatives cannot be overstated.

Conclusion

Women in the Mediterranean agricultural sector are driving a transformative shift in gender dynamics within rural livelihoods. Overcoming historical disadvantages and the masculinization of rural populations in southern Europe, women are reclaiming recognition for their vital role in agriculture through collective mobilization and social media. Women are increasingly asserting their autonomy beyond stereotypical gender roles, opting to enter the labour market and decision-making spaces in economic (e.g. cooperatives) and political (e.g. councils) arenas.

The interplay between the feminization and masculinization of rural populations in drylands underscores the need for gender-responsive approaches to land management and rural development. Empowering women and ensuring their active participation in the rural area is not only a matter of social justice but also a strategic imperative for achieving the Sustainable Development Goals. By harnessing the traditional knowledge, skills and leadership of women, the Mediterranean region can build more resilient and thriving rural communities that are well equipped to tackle the challenges of climate change and land degradation.

In the NENA region, the feminization of agriculture offers a significant opportunity to enhance female empowerment through cultural shifts and policy reforms that improve women's legal rights to land access and ownership, and access to resources. To enable more significant women's influence in business decision-making and equitable distribution of income and benefits, transformative changes supported by tailored gender-responsive policies are crucial. This should be combined with increased investments and the scaling-up of land and water management, as well as sustainable development and restoration projects in Mediterranean rural areas.

The compelling case studies from Spain and Lebanon illustrate a paradigm shift in which women-led initiatives leverage social media to unite and amplify their representation, bringing tourism and agrifood businesses to remote rural regions. Notably, the collective actions of women exhibit heightened environmental and climate awareness as they direct their efforts toward sustainable agricultural practices that align with natural landscapes. Their capacity to mobilize citizens and adopt gender-just solutions for land restoration, despite limited financial resources, significantly contributes to rural development. Furthermore, their ability to strategize with various technical and public stakeholders – public and private alliances for development – has been highly effective. Such collaboration results not only in improved livelihoods but also in collective advocacy actions to push for policy changes that systemically address gender inequalities in representation roles, access and control over land, technologies, and credit and training opportunities. WADA in Lebanon, and ACOAN and Ganaderas en Red in Spain, illustrate the emergence of women leaders committed to land restoration and improving the governance of rangelands and rural areas. These initiatives leverage social media, collective action, and sustainable agricultural practices to enhance livelihoods and promote environmental stewardship. Such models should be scaled up and replicated across the Mediterranean region.

Women in agropastoral and forest sectors are not only key agents of change but also essential to the sustainable development of Mediterranean drylands. Their innovative practices and leadership in land management significantly contribute to combating desertification and enhancing ecosystem resilience. To fully harness their potential, it is crucial to implement supportive gender-responsive policies, address gender inequalities, and foster an inclusive environment where women can thrive as leaders in sustainable agriculture and land restoration. Their voices need to be heard through equitable representation in all institutions, fora and initiatives engaged in agricultural planning and land management, land restoration policies and decision-making. Women's dedication to land restoration underscores a commitment to sustainable agriculture, emphasizing the importance of harmony between agricultural activities and the delicate ecosystems of the Mediterranean.

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Monitoring restoration in the Mediterranean region

Drone flying under the tree canopy capturing images in a pine forest in Soria, Spain, to quantify diameters and heights of individual trees

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Monitoring is an essential part of any restoration project. It is a comprehensive process that includes the systematic collection, analysis and dissemination of data. It is also an important element of a well-balanced restoration implementation strategy, and the way to check the success of restoration efforts.

Monitoring allows to:

- guide the implementation of the project through continuous learning;
- ensure transparency and provide evidence of progress, results and impacts;
- communicate positive results;
- provide evidence to investors; and
- support regular reporting on progress towards achieving goals and commitments.

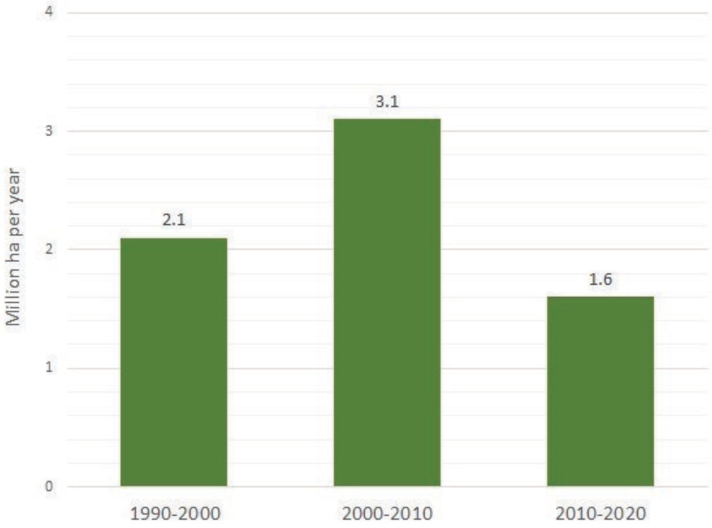
A sound monitoring framework should be built during the project proposal phase and aligned with the project objectives, and it should include and take into account different types of indicators that go beyond vegetation monitoring, reflecting socioeconomic (Tedesco *et al.*, 2023) as well as ecological processes (Herrick, Schuman and Rango, 2006). Furthermore, participatory monitoring should always be considered when possible, involving the local population and adapting the system and indicators to their needs and requirements (Evans, Guariguata and Brancalion, 2018).

Importance of monitoring restoration efforts

On 1 March 2019, the United Nations General Assembly proclaimed 2021–2030 the United Nations Decade on Ecosystem Restoration (the "Decade") following a proposal for action supported by over 70 countries. It is estimated that the cost of global land restoration will reach at least USD 200 billion per year until 2030. Currently, degradation results in the loss of ecosystem services valued at over 10 percent of the world's economic output, affecting the well-being of 40 percent of the global population (UNEP, 2021). Given these challenges, the monitoring of restoration efforts becomes crucial for assessing progress and attracting public and private investments. However, despite the availability of affordable and powerful monitoring tools, systematic ecosystem monitoring remains rare (DeLuca *et al.*, 2010).

Despite the global consensus and communication efforts for ecosystem restoration, which contributes to achieving multiple Sustainable Development Goals (SDGs), the annual trend of increasing forest restoration area has declined over the last few years (Figure 1). This reduction and the lack of efficiency hamper the achievement of the restoration goals set during the previous decade, such as aiming for

Figure 1. Annual net change in area of other planted forests (taken to include restored forests), 1990-2020



Source: FAO. 2020. *Global Forest Resources Assessment 2020 – Key findings*. Rome. https://doi.org/10.4060/ca8753en

350 million hectares (ha) restored by 2030 (e.g. the New York Declaration on Forests and the Bonn Challenge) and targeting 1 trillion trees by 2050 (the Trillion Trees initiative).

The monitoring of ecosystem restoration projects is often neglected despite its importance. Many projects fail due to factors such as technical design, lack of scientific knowledge, inadequate adaptation to specific sites, lack of stakeholder involvement, execution failures, insufficient worker training, social non-acceptance, ecologically dysfunctional approaches and economic non-viability. Unforeseen aspects can also hinder project success. For example, despite spending USD 13 million on mangrove restoration in Sri Lanka following the 2004 Indian Ocean tsunami, only about 20 percent of the planted area showed successful growth after 10

Why do restoration projects need monitoring?

The monitoring of restoration projects is important because it can:

- detect changes in ecosystem processes and functions;
- enhance project efficiency and assess trends in biodiversity;
- provide early warning of threats and measure the success or failure of interventions;
- evaluate implemented actions and adjust restoration strategies for increased success;
- generate technical knowledge on ecological restoration across different ecosystems;
- assess system changes and alignment with proposed objectives;
- optimize resources through adaptive management focused on objectives;
- ensure sustainable use and management of natural resources;
- recognize collective benefits through improved ecosystem services;
- foster project continuity and community ownership through participatory approaches;
- enhance planning, objective setting, transparency and stakeholder trust;
- secure support and funding by demonstrating project efficiency, effectiveness and impact;
- monitor investment and evaluate its efficiency; and
- enable learning through continuous improvement.

Source: Aguilar Garavito, M., Avella Rodríguez, C., Cabrera, M., De Lima Niebles, V., Franco Morales, M.A., Hernández Palma, A.M., Herrera Varón, Y. *et al.* 2021. *Evaluación y seguimiento de la restauración ecológica en el páramo Andino*. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. http://hdl.handle.net/20.500.11761/35916 years (Kodikara *et al.*, 2017). Additionally, active restoration efforts may have lower success rates compared to natural regeneration (Crouzeilles *et al.*, 2017). Monitoring can detect early signs of decay and address issues before projects fail. It is also important to consider and mitigate any undesired negative effects generated by restoration activities (DeLuca *et al.*, 2010).

Monitoring should encompass technical, environmental, ecological, social and economic aspects of restoration projects. It is crucial to establish a comprehensive data-collection system that evaluates resource utilization and the degree of objective achievement in the short, medium and long term. Monitoring serves as a key element for decision-making in complex systems (Suding and Hobbs, 2009). Moreover, monitoring must align with the project's scope, objectives, methodologies, resource allocation, types of analysis, and dissemination of results. Comparison with reference sites and the inclusion of social and economic considerations, as demonstrated by carbon project standards (e.g. CCB, Gold Standard and SD VISta), further enhance monitoring practices and ensure the sustainability of the restoration intervention in the long term (Cariño Fraisse, 2022).

Performing monitoring activities accurately is crucial. This requires technical training for workers, rectification of failures, and proper collection, recording and storage of data. Subsequent data processing, including robust statistical design, modelling, error calculation and propagation, is essential.

The social and economic dimensions of restoration projects

Enhancing the well-being of people, reducing poverty, increasing the supply of ecosystem services or promoting sustainable use of terrestrial ecosystems are some of the defining nature restoration objectives set by the major agreements driving the current restoration movement: the Bonn Challenge, SDG 15 "Life on Land", the Decade and the United Nations Convention on Biological Diversity (UNCBD). These social and economic goals impel part of the resource mobilization towards ecosystem restoration. However, many restoration projects do not specifically include social and economic goals and do not monitor effects on these aspects (Fleischman *et al.*, 2020; McElwee and Nghi, 2021).

Relationships between well-being or poverty and the actions we undertake to restore the environment are conditioned by multiple factors, making it difficult to understand the impact of those actions. Experience tells us that actions to change the environment give us a chance to improve social and economic conditions as well. However, the probability of improving these is reduced when actions are designed ignoring them (Mansourian *et al.*, 2017; Wortley, Hero and Howes, 2013). Indeed, as Holl and Brancalion (2022) indicate when considering the huge amount of restoration projects that are currently being undertaken, the current risk of doing more harm than good is very high, be it on a social, economic or ecological level. As a priori predictions in complex systems are almost intractable in the medium term, our best tools both to reduce the risk of undesirable economic and social consequences and to increase the resulting value of restoration projects are first to monitor the effects of these dimensions and second, to apply an adaptive management approach to restoration based on these effects, in time to correct mistakes.

Further than the obvious importance that effects on human issues have for us, the social and economic effects of restoration projects are highly significant for the restored environment. Human decisions depend on perceived values, which in turn depend to a large extent on received values (Cáceres *et al.*, 2015; Glynn *et al.*, 2017). That is to say, the human effects of these projects will reflect the new decisions on restoration and on the use of restored environments. The permanence of environmental improvements boosted by restoration projects therefore greatly depends on the social and economic effects that people received from those projects.

These social and economic parameters should be included as part of adopting a monitoring, evaluation and learning system (Mahajan *et al.*, 2023). Such systems create a more dynamic monitoring framework, increase the quality of monitoring and evaluation processes and contribute to sustainable development by empowering communities and promoting a culture of continuous improvement.

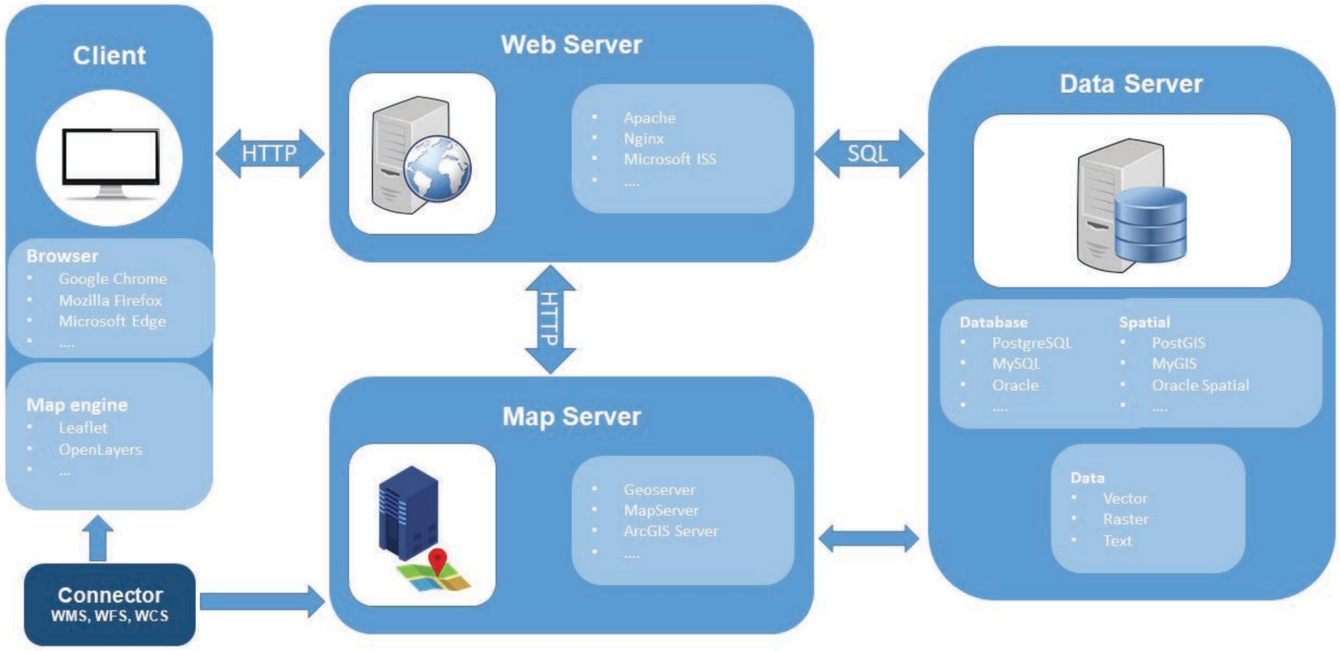
Ideally, the monitoring of a restoration project should embrace ecological, social and economic dimensions, considering the main affected stakeholders in the short, medium and, if possible, long term. However, monitoring is complex and costly, especially if it includes parameters about all these dimensions. Making the monitoring of social and economic aspects easier for practitioners would surely encourage them to use it more frequently. This would greatly increase learning and the value derived from nature restoration.

Monitoring tools

Monitoring systems include data collection, both *in situ* and remotely, data processing and data visualization or reporting. Traditionally, forest mapping and monitoring have been a costly and time-consuming process, but new developments, especially in the field of remote sensing, the Internet of Trees using *in situ* devices, and artificial intelligence (AI) for the processing of this information, are expected to make monitoring easier (de Almeida *et al.*, 2019; Marvin *et al.*, 2016). Larger areas can now be monitored using these new technologies, especially via remote sensing.

For instance, active remote sensors can accurately estimate vegetation height, related to indicators widely used to monitor restoration projects like cover type or biomass (de Almeida *et al.*, 2019; Torresan *et al.*, 2021). Passive remote sensors can also monitor forest restorations. Examples of this are the information on trends or the identification of the reduction of tree foliage that different vegetation indices can provide (Almeida *et al.*, 2019; Otsu *et al.*, 2018). It is also possible to monitor the canopy structure and

Figure 2. Basic Web GIS components



Source: Cesefor

forest biomass using stereo images (de Almeida *et al.*, 2020).

Static sensors and mobile devices can collect data from the field. Wireless sensor networks are designed to cover large areas without the need for physical infrastructure, so they are widely used for forest monitoring. They consist of a group of devices equipped with sensors that transfer the data collected to a server via a wireless network. Their main characteristic is the continuous real-time data collection. They are used to monitor structural changes in the trees (e.g. radial growth) or measure the environmental conditions of the site.

All these technologies generate a huge amount of data, but advances in the field of AI allow us to deal with big data. However, the lack of homogeneous data sources and different data structures from different organizations and initiatives around the globe remain a barrier for data management (Zou *et al.*, 2019).

Typically, monitoring systems must be multifunctional with a prominent mapping component, but statistical dashboards with aggregated data may be suitable for a non-technical audience. Figure 2 presents the architecture of a basic web-based geographic information system (GIS).

Tools can be classified according to different criteria, such as model distribution type, scale, functionalities, scope of application or the organization responsible, among others. These tools come as stand-alone GIS applications such us **QGIS** (open source software) or **ArcGIS/ArcMap** (proprietary software), or web platforms such as **Google Earth Engine**, a well-known cloud-based tool with large computational capabilities and a huge remote sensing catalogue. There also tailor-made web platforms, such as **Global Forest Watch**, **Resource Watch** and **Restor**, in which the functionalities are already implemented and the end user incorporates their data. Some tools are designed for field data collection using the capabilities of mobile devices, sometimes used as part of citizen science projects, such as **Regreening app** or **Tree mapper**. Other tools focus on monitoring ecosystem indicators, such as **Trends.earth**, sometimes focusing on a specific one, like **Veritree** for carbon sequestration.

Among all the available tools useful for monitoring at different scales, it is worth mentioning several developed by FAO to help countries with different monitoring needs. The Assessment, Understanding and Reporting Of Restoration Actions (**AURORA**) tool, based on the methodology jointly developed with the World Resources Institute (WRI) (FAO and WRI, 2019) helps stakeholders develop a monitoring system tailored to their needs by identifying indicators and metrics for monitoring progress towards their goals. **Collect Mobile** is part of FAO's Open Foris initiative and can be used for field data collection and validation, including socioeconomic information collected through household surveys. **Collect Earth** is a tool for remote biophysical data collection, which has been widely used for different purposes including restoration. It enables land-use data collection through Google Earth for establishing reference levels and monitoring the dynamics of land-use change by accessing available high- and very high-resolution satellite imagery. Finally, users can refer to the System for Earth observation data access, Processing and Analysis for Land monitoring (**SEPAL**), which allows users to query and process satellite data quickly and efficiently, tailor their products for local needs, produce sophisticated and relevant geospatial analyses, and produce classification maps using data collected with Collect Earth.

In addition, standards initiatives such as those by Preferred by Nature, WWF and the Society for Ecological Restoration, provide tools for measuring project success and facilitating communication, performance evaluation, adaptive management and necessary corrections.

To ensure successful restoration outcomes, it is also vital to establish standards for measuring restoration success. Common criteria adopted by all stakeholders (e.g. funders, practitioners and citizens) help define and evaluate ecological success in restoration while considering learning, stakeholder impact, cost-effectiveness and other relevant aspects (Palmer *et al.*, 2005). In this regard, some initiatives to establish common frameworks are underway. At global level, in the context of the Decade (UNEP and FAO, 2020), different initiatives and tools have been or are being developed to help stakeholders at different levels monitor and report on their restoration efforts. In the context of the Decade, FAO is leading the Taskforce on Monitoring (FAO, 2023), which brings together over 300 experts from more than 100 organizations. The main task of this expert group was to develop a monitoring framework to track and report on restoration efforts in a consistent and transparent way, and the result was the Framework on Ecosystem Restoration Monitoring (**FERM**). FERM will be used to report on progress under the Decade and the Global Biodiversity Framework Target 2 but also on other initiatives such as projects funded by the Global Environment Facility (GEF). FERM has two components, one for entering restoration data and documenting best practices (the registry) and one for visualizing the data (the geospatial platform).

Tools used in the Mediterranean region

The lack of a common forest strategy and shared mechanisms and definitions in the Mediterranean region leads to a reliance on project-based tools and national solutions instead of global approaches (ETC-UMA and EEA, 2023).

Nevertheless, there are many national initiatives, and some of them are presented in this article. Below is a brief overview of examples in Morocco and Lebanon, and a more in-depth analysis in Spain.

Morocco

The Collect Earth tool from FAO's Open Foris initiative has been used since 2014 in a project in Morocco to develop national land cover maps and monitor changes. In addition, a series of new technologies are being developed and are in the testing phase, based on using AI for the detection of forest offences, terrestrial LiDAR data and drones for different applications, such as the mapping of forest areas or the monitoring of forest fires and plantation success (ETC-UMA and EEA, 2023).

Lebanon

The Forest Registry is a tool developed for and by the Ministry of Agriculture and designed to be an essential tool for monitoring land management activities related to reforestation, forest management and rangeland management. Its main purpose is to assist the field personnel in collecting and transmitting data to the ministry's headquarters. The type of data collected covers several themes such as reforestation (e.g. extent and survival), grazing permit surveillance, wood collection permit surveillance and more. An application is being developed and tested that will make it easier to collect data in the field and share them with a centralized database. At this stage, the registry is not fulfilling its role in monitoring land management activities due to the economic problems that the country is facing. Engineers and field personnel are unable to conduct frequent field visits to populate the database.

Specific monitoring tools have been developed for specific projects, such as the PARSIFAL project funded by the French Development Agency (AFD). The PARSIFAL project has developed a web tool to monitor the success rate of reforestation activities and track the causes of any failures. This tool is an essential asset for local managers aiming to remediate the situation as soon as possible.

Finally, the ministry collects reforestation data annually from leading reforestation and land restoration non-governmental organizations and uses the data to estimate the total reforestation area.

Case study: Information Management System of the Agricultural Land Afforestation Programme in Castile and León, Spain

Castile and León, Spain, is the fifth largest region in the European Union and the largest in the Mediterranean area (at NUTS 2 level[25]). It has a forest area of nearly 3.3 million ha and a long tradition of reforestation. In 1993, this region joined a European aid scheme for forest restoration as part of the reform of the European Union's common agricultural policy. This aid takes the form of subsidies to landowners who establish forest areas on their agricultural land, according to the criteria and conditions established by the regional governments. As a result, Castile and León developed the Plan de Forestación de Tierras Agrícolas (Agricultural Land Afforestation Plan) as an ambitious forest restoration programme covering both public and private land. Since its implementation, this afforestation programme has kept up-to-date with successive European and national legislation and with the technical changes of the last 30 years (Iglesias Ranz *et al.*, 2021). The European Union finances part of the programme through the European Agricultural Fund for Rural Development (EAFRD), and the national and regional budgets finance the rest. To date, more than 200 000 ha have been afforested under the programme.

Specifically, the four most important objectives of the programme are currently to:

- increase the forest area to avoid erosive processes, soil

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[25] The NUTS classification is used by the European Union to divide its territory into land units for the purpose of harmonizing European regional statistics. NUTS 2 is for "basic regions for the application of regional policies".

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Aerial view of a new forest plantation under the Agricultural Land Afforestation Plan, Castile and León, Spain

degradation and water quality degradation, by withdrawing land from cultivation;

- create vegetation cover to offer protection against natural disasters and regulate the basin's hydrological regime;
- mitigate the negative effects of climate change, increasing carbon dioxide capture through the establishment of new forest plantations created with species adapted to local characteristics and conditions; and
- increase the biodiversity of areas with little natural value, with special attention to forest species and management systems that can be profitable in the medium and long term.

The monitoring of forest plantations first involves checking their establishment, through fieldwork. Thus, each year, the new plantations are mapped and surveyed for compliance with the required technical specifications. Around 1 000 plots of previous plantations of different ages and characteristics are also surveyed to check their condition and decide on their eligibility for receiving funding. The size of the trees during the initial years, their ability to blend in with competing vegetation, the small size of the restored areas or the precision required, often make fieldwork essential as opposed to remote sensing. However, the latter, and especially aerial orthophotography, are an important occasional support (e.g. in older or more developed forestations or in targeted sampling). Silvicultural data currently collected in these plots cover the following:

- density of live plants;
- vegetative state;
- phytosanitary state;
- relative position of the tree with regard to the competing vegetation;
- height (in intervals);
- diameter (in intervals); and
- silvicultural intervention (e.g. pruning, thinning or treatments on competing vegetation) in the plot.

The programme has resulted in a huge amount of information in different storage file formats and data models over time. In order to use these data for monitoring and apply adaptive management in the programme (Adams, 2015), the Regional Council of Castile and León (Junta de Castilla y León) promoted an ambitious project of information management in 2015. This led to the current Information Management System of the Agricultural Land Afforestation Plan in Castile and León (SISREP) (Jovellar Lacambra *et al.*, 2022), whose first full usable version – SISREP 1.0 – was made available in early 2023.

SISREP's goals were to:

- produce up-to-date digital maps of every forest plantation created in the programme;
- design and implement a centralized, georeferenced, accessible, adaptable and up-to-date

database containing data from field surveys on forest plantations;

- design and implement a digital recording system of field survey data, to feed the database and speed up field reporting;
- develop a web-based tool for accessing the stored data;
- assist the decision-making process by developing new tools to predict the success of future forest plantations; and
- develop an adaptable system architecture capable of integrating new uses.

SISREP 1.0 achieved its initial goals. Its design (Figure 3) includes the following components:

1. The **database**, which includes:

- Digital mapping, updated every 3 months, of the forest plantations created by the programme. This mapping functionality includes information on the plantations, such as plantation date, certification date, forest species used and in what proportions, soil preparation method, initial plantation density, ownership type, subsequent silvicultural treatments and administrative data. Currently, this geodatabase stores more than 126 000 registries.
- Thematic mapping data from external data sources, such as altitude, orientation, slope, lithology, physiography, soil pH, water retention capacity, annual mean temperature, dryness index and summer rainfall. This information is added to each field observation by automated geoprocessing.
- Digital mapping and alphanumeric information collected via fieldwork and entered in the system describing the surveyed plots. Plots are circular with a surface of 200 square metres (m^2). Number of live planted trees and control date are among the information recorded. Survival rate and plantation age at inspection are obtained as a result of their combination with the information provided from the forest plantation layer.

2. A **digitalized system for registering control fieldwork data** that dynamically updates the database. The software solution developed consists of two tools. On one hand, a field data-collection web manager, and on the other hand, a software application for Android devices for field data collection; both tools are connected to the database. The web manager is used to design fieldwork controls and prepare the necessary documents to carry out the site visits. The SISREP Android software application receives information from the web manager and collects data during fieldwork, automatically updating the SISREP database.

3. **Predictive models** developed for SISREP. They use the SISREP database to predict, at a specific geographic point and for a specific forest species, the survival percentage and the probability that this estimated survival percentage is higher than a fixed threshold. SISREP integrates two predictive models: a predictive model and a probabilistic one, developed using an ensemble of random forests (Liaw and Wiener, 2001) and eXtreme Gradient Boosting (R Core Team, 2021) using the R program (R Core Team, 2021). The regression model uses a regression as an ensemble, and the probabilistic model uses the arithmetic mean as an ensemble. After an exploratory analysis, explicative variables that minimize errors were selected. To do this, the procedure of recursive removal of variables using the random forests method and bootstrapping was applied, using previous information about variable significance. The Caret Library (Kuhn, 2008) of the R program (R Core Team, 2021) was used.

4. A **Web GIS tool** to make use of SISREP database information with several functionalities, such as visualization, spatial and statistical analysis, access to the data and forest restoration success predictions.

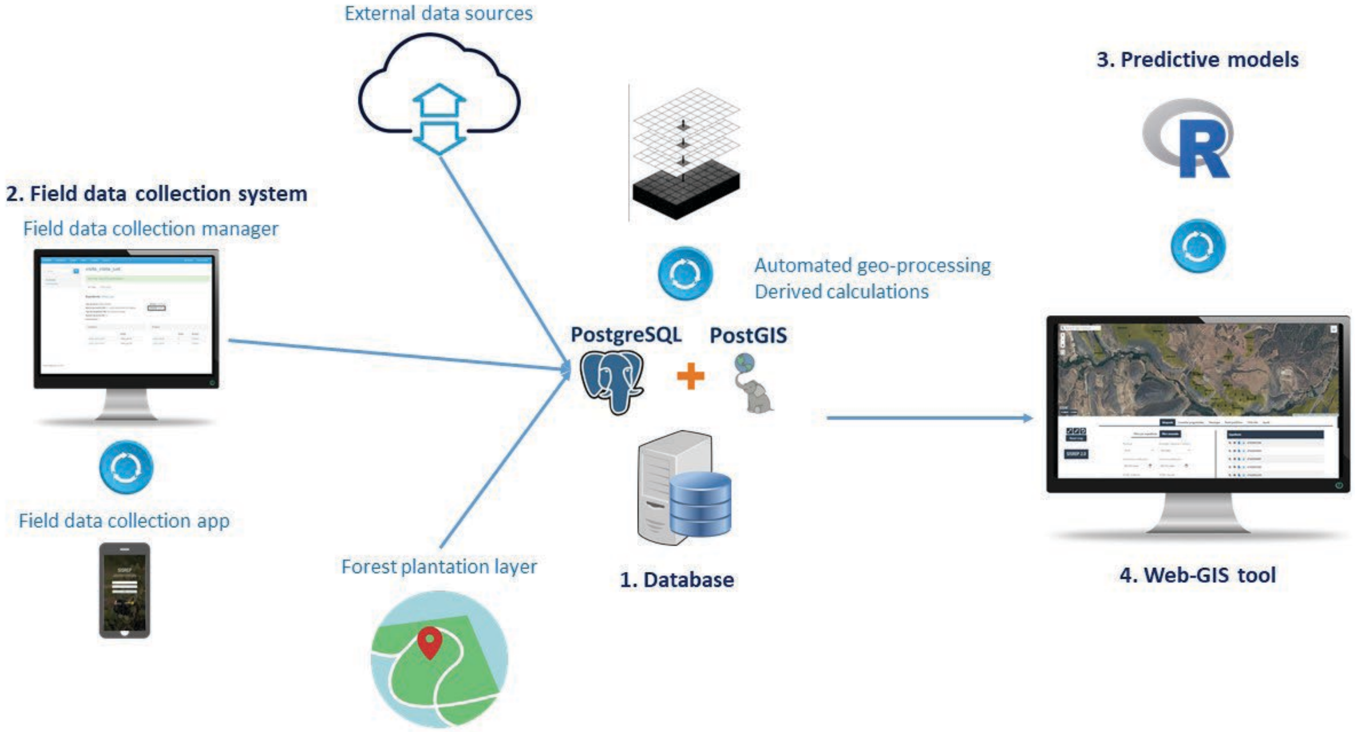
SISREP 1.0 is the first version of a valuable tool that speeds up and optimizes the work of forest plantation creation and monitoring in agricultural lands, supporting the decision-making process and adaptive management. Thanks to this tool, it is now possible to analyse forest plantations, their characteristics, outcomes and evolution, and their relationships to other ecological, social and economic parameters. However, the development of SISREP 1.0 extended over almost 8 years. This experience shows that the development of monitoring systems may be difficult and slow for many local projects. Making it easier to access and implement adaptable monitoring systems may help promote wider adoption of monitoring in forest plantation projects or any other restoration project, thereby enabling the success of nature restorations.

Conclusion and the way forward

Conclusion

Monitoring must be an integral part of restoration projects. Its proper implementation is essential to measure their social, environmental and economic goals and impacts, redirect actions early on and learn from experience how to improve future projects. In fact, monitoring is a learning process in itself, which allows adjustments to be made on the go. Monitoring increases the value of restoration projects and optimizes investments. Many tools are already available to adapt monitoring to each situation and to reduce costs, and initiatives are underway to establish common frameworks and methodologies in this field. In the Mediterranean region, monitoring plans and programmes are being developed to evaluate and improve recovery plans; this article has reviewed three of them showing the diversity of possible approaches.

Figure 3. Design of SISREP


External data sources
3. Predictive models
2. Field data collection system
Field data collection manager
Automated geo-processing
Derived calculations
PostgreSQL
PostGIS
Field data collection app
Forest plantation layer
1. Database
4. Web-GIS tool

Source: Cesefor

The way forward

Harmonizing the different monitoring initiatives in the region within a common framework would help make them comparable, among other advantages, which in turn would lead to improved restoration strategies. The use of methodologies that share concepts, indicators and approaches while being adaptable to each specific project would make monitoring easier to implement and improve learning, thereby facilitating the adoption of monitoring, evaluation and learning principles.

The dissemination of resources and the promotion of fora and training plans in monitoring should be priorities of government bodies and institutions. Research can also play an active role in improving tools and procedures based on monitoring data.

Monitoring in the Mediterranean region should strengthen the evaluation of social and economic factors, as this is not common practice. Project developers should take into consideration the effect of restoration on the well-being of local communities and their involvement in the monitoring process.

Monitoring may become more and more frequent in the Mediterranean region in view of the number of restoration projects expected in the coming years. This is a great opportunity to address current implementation problems and reap all the benefits that the monitoring of nature restoration can offer.

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The power of communication to enhance restoration in the Mediterranean region

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Why communicating about restoration in the Mediterranean region is paramount

Mediterranean landscapes are highly vulnerable to environmental stressors, such as wildfires, droughts and land degradation, which significantly impact the health of their forests. Given this vulnerability, effective communication is pivotal in creating widespread awareness of the urgent need for forest restoration. Public awareness campaigns, educational programmes and outreach initiatives are vital tools for informing local communities, policymakers and stakeholders about the significance of rejuvenating these ecosystems. By highlighting the benefits of healthy forests – including biodiversity conservation, carbon sequestration and watershed protection – communication serves as a catalyst for garnering public support and engagement.

Moreover, the Mediterranean's complex socioeconomic structure demands tailored communication strategies. Different regions within the Mediterranean possess unique cultural norms, economic challenges and historical connections to their forests. Successful communication involves respecting these diverse perspectives and integrating them into restoration initiatives, ensuring that local communities are active participants in the process. It fosters a sense of ownership and responsibility, making restoration efforts more sustainable and effective in the long term.

The Mediterranean region stands at a crossroads of various geopolitical influences, with multiple countries sharing these landscapes. Effective communication is essential in promoting cross-border collaboration and information sharing. Encouraging transnational dialogue and cooperation through various communication channels is vital for ensuring coordinated efforts and harmonized policies, and sharing best practices across borders.

Effective communication is a cornerstone of the success of forest restoration in the Mediterranean. By fostering awareness, engaging diverse stakeholders and promoting cross-border cooperation, communication plays a pivotal role in advancing the cause of restoring and preserving the Mediterranean's invaluable forested landscapes.

This article explores the role of communication in the field of forest restoration in the Mediterranean region, shedding light on how it can advance the cause of restoration and environmental conservation.

Communication and science: the challenges of communicating about restoration

Effective communication of research-based scientific information to the general public remains a challenge for the scientific community. The past decade has seen an influx of data, facts and scientific information being shared, which has often seemed overwhelming and inaccessible to many.

While accuracy and evidence-based information are essential, presenting numbers and complex figures without relatable narratives can lead to disengagement and indifference among the general public.

Reviews conducted for 130 000 ads from over 1 000 brands show that the attention memory threshold is 2.5 seconds (Eye Square, 2020). This means that communicators have a very brief window to capture the attention of audiences and make an impact. The data suggest that a staggering 85 percent of communication efforts fail to reach their target audience. This failure may be attributed to various factors, including poor messaging, lack of relevance, or ineffective delivery of the content.

Communicating complex technical messages about forest restoration in the Mediterranean region is a major challenge. One of the main hurdles lies in the technical complexity inherent in restoration efforts, which may involve biodiversity conservation, improving soil health, and selecting suitable reforestation methods and fire prevention strategies. Conveying these technical aspects in a manner that is both comprehensive and comprehensible to diverse audiences with varying levels of expertise presents a significant challenge.

The diversity of Mediterranean landscapes complicates the communication process further. Messages must be tailored to suit specificities on the ground and made accessible to all.

The region's cultural and linguistic diversity adds another layer of complexity. Effective communication requires overcoming language barriers and ensuring that technical jargon is translated accurately while maintaining scientific accuracy. Ensuring cultural relevance across borders and communities within the region is equally critical.

Engaging stakeholders in understanding the technical nuances of forest restoration is a critical aspect. Stakeholders include policymakers, local communities, scientists, non-governmental organizations and the general public. Crafting messages that not only inform but also motivate is essential to garner support and participation in restoration initiatives, requiring nuanced and strategic communication.

Addressing these challenges requires innovative communication strategies.

What strategies can be used to make the science behind forest restoration more understandable to a broader audience?

Former Secretary-General of the United Nations Ban Ki-Moon once stated: "Help us transform a complex and abstract agenda into a personal and emotional story about how we can build a better world" (Ban Ki-moon, 2016). During his mandate, he emphasized the importance of transforming complex and abstract global agendas into personal and emotional stories to engage people and inspire collective action for building a better world.

Impact and behavioural change at the population level are achieved when campaigns successfully raise awareness by demonstrating how problems of great importance affect the planet and humanity.

Using non-traditional strategies, plans and tools in approaching the communication of science may lead to more impactful outcomes.

For example, a majority of both science and non-science major students found that including humour made scientific articles more appealing while only a minority felt that it weakened the credibility of the scientific information, as highlighted in several studies (see for example Chan and Udalagama (2021)). Such studies show that humour is an effective way to engage readers, regardless of their background or education, as it has the potential to transform complex topics into more understandable and enjoyable information, leading to increased audience interest and attention (Pinto and Riesch, 2017; Yeo and McKasy, 2021).

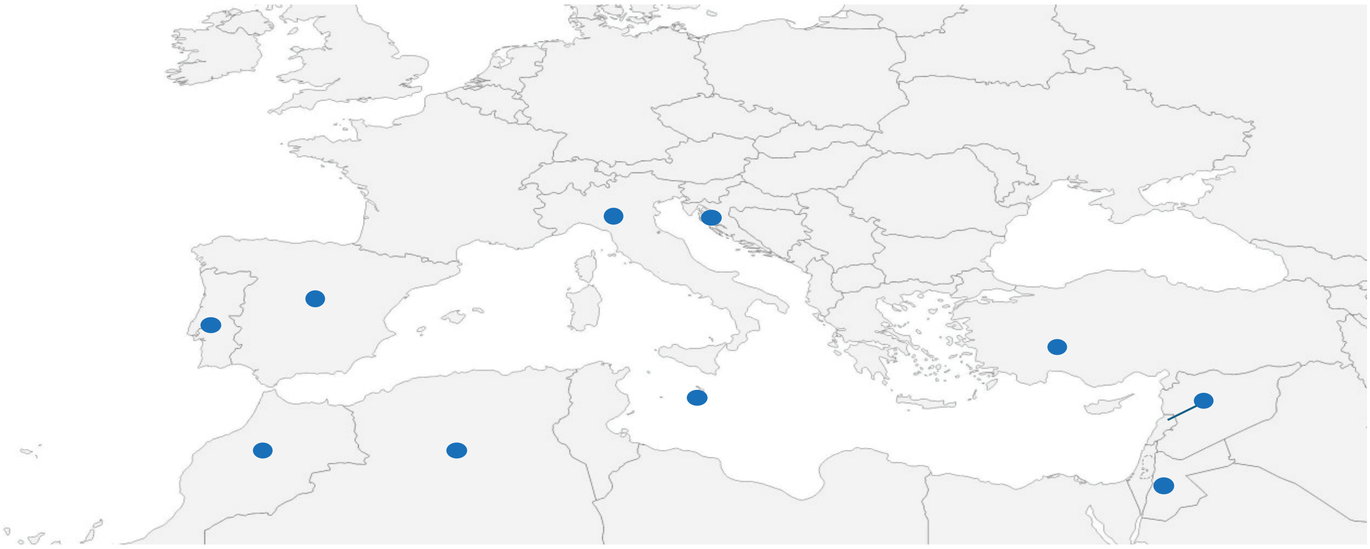
One study has shown that exposure to climate change memes can increase individual online civic engagement on climate issues (Zhang and Pinto, 2021). Such internet memes are simple and innovative creations enabling messages to be more easily delivered and interpreted. In addition, they are created anonymously and do not need to deliver facts or provide evidence. This offers an opportunity to influence the viewpoints and opinions of viewers in a manner that is potentially much more effective than through traditional media channels as shown below.

"L'Adieu des Glaciers" stands out as a highly effective example of science communication. This collaborative project involving the University of Turin, Forte di Bard and the Italian Glaciological Committee employs visual communication to inform and captivate both local communities and a global audience. By delving into photographic archives spanning over a century, scientists meticulously gathered data from various fields and used imagery to depict the condition of glaciers in a way that is understandable beyond scientific circles. Every year, a public exhibition showcases the changes in the glaciers of the Aosta Valley, illustrating their retreat over centuries. In studying these glaciers, scientists have unearthed discoveries such as mummified organisms and historical remnants, shedding light on human history in mountainous regions and prompting further research into these ecosystems. The project's goal is not only to raise awareness but also to nurture a sense of environmental responsibility. To achieve this goal, the research team is actively involving schools and universities by organizing competitions and activities that engage students and encourage them to better understand and care for the environment.

To be effective and ultimately inspire action, communication should be light-hearted, suited to the needs of the audience, and focused on developing empathy by establishing an emotional connection with it. Shifting from traditional communication methods to more engaging and fast-spreading tools and messages can create an impact.

There are innovative ways to successfully communicate science that can

Figure 1. Map of FCNMedNE members in the Mediterranean region



Source: UN Geodata simplified

engage the general public and encourage people to reflect on the relevance of the issue at hand in their daily lives, and take action.

Increased interactions with the public can effectively inspire new champions for research who lobby for science.

The steps to getting a message heard are first to listen to the diverse views of all stakeholders and understand their challenges, and then to turn complex scientific notions into simple relatable messages.

Following many years of unheeded warnings and messages about the environmental crisis, it is time for science communication to break through.

David Attenborough, a well-known broadcaster, biologist and natural historian, has dedicated his life to making nature documentaries and advocating for wildlife conservation. His statement, "Saving our planet is now a communications challenge" (BBC Media Action [@bbcmediaaction], 2021) emphasizes the critical role of powerful communication in addressing environmental issues and promoting sustainable practices.

The Sustainable Development Goals (SDGs) of the 2030 Agenda also represent a noteworthy example of successful science communication. The United Nations transformed a complex agreement into 17 easily digestible icons. This has been instrumental in their widespread adoption and implementation across the globe. As 2030 draws closer, the SDGs are still perceived as strategic milestones for sustainable development and serve as a model for effective communication. Their success as a communication tool demonstrates the power of presenting complex challenges in a clear, accessible and inspiring manner to mobilize collective action towards a more sustainable and equitable future for all.

It is important to unlock the power of communication to disseminate science and related scientific topics and turn science into action. The following sections illustrate how the Mediterranean region has communicated successfully and effectively to the world on the issues that affect it.

Exploring communication in the Mediterranean region

Communication holds great power in shaping opinions, creating movements, influencing policies and inducing change at the local, regional and international levels. It is an influential tool for fostering knowledge, shaping opinions and influencing decision-makers. Communication enhances public awareness public by disseminating information and directing action and support. The Mediterranean region has initiated many influential communication activities, including collective efforts to influence and inspire change and impact the forest community, from decision-makers to beneficiaries.

One notable initiative is the Forest Communicators Network for the Mediterranean and Near East (FCNMedNE). In 2013, FAO provided support to establish a communicators' network to serve as a platform for the exchange of views, opinions and knowledge throughout the Mediterranean region. Forming part of the wider Regional Forest Communicators Networks, which comprise six networks across five regions, the FCNMedNE includes more than 120 members from 16 countries. All Mediterranean countries are represented in addition to a number of others, such as Belgium, Finland, the Islamic Republic of Iran and South Africa, which allows a constructive exchange of information and knowledge and helps shape public opinion on the Mediterranean forests, climate and practices.

The FCNMedNE is also officially responsible for facilitating communication during the Mediterranean Forest Weeks (MFWs). These events gather together the region's scientific community working in forestry and disseminate messages to a broader audience, promoting science and research.

Figure 2. Tune to the Forest virtual cafés are an example of successful collaboration between the FCNMedNE and the Mediterranean Youth Taskforce

TUNE TO THE FOREST
Mediterranean Youth Task Force
TUNE TO THE FOREST
Sanjay Mishr
Thursday, Nov 24 4pm CET
Exploring Nature-Based Solutions For Social Challenges
Register Now
Silva Mediterranea
Mediterranean Forest Communicators Network

© FCNMedNE/Patricia Sfeir

In 2018, the Union for the Mediterranean (UfM), together with the EU Interreg Med Programme, the University of Siena and the Italian Institute for Environmental Protection and Research (ISPRA), launched an important initiative that received international praise called the "Plastic Busters CAP: Fostering Knowledge Transfer to Tackle Marine Litter in the Mediterranean Marine Protected Areas." This project aimed to combat plastic waste in Mediterranean marine protected areas. It was extended in 2022 with a follow-up initiative: "Plastic Busters CAP: Fostering Knowledge Transfer to Tackle Marine Litter in the Mediterranean." The project aims to share best practices from the Plastic Busters initiative and leverage additional resources and expertise to achieve greater impact.

MedForest is an open-access platform created by the European Forest Institute's Mediterranean Facility (EFIMED). This regional initiative highlights contributions from regional stakeholders in the form of news, events and research all related to the Mediterranean forest context. It acts as a reference in communicating about forests by addressing major opportunities for development at the regional and international level.

Youth are also involved in communication, leading the way for a better future for everyone. Young foresters who are passionate about forests and forest-related issues, have come together to create the Mediterranean Youth Taskforce (MYTF). The MYTF offers young foresters and practitioners a space for dialogue, exchange of knowledge, collective action and behavioural change. More than 100 young foresters are engaged in shaping regional and global policies and strategies for the future development of forests in the Mediterranean.

The Mediterranean restoration initiative "Restoring Mediterranean Forests" recognized as a World Restoration Flagship

The Mediterranean region has recently been nominated as a World Restoration Flagship in the context of the United Nations Decade on Ecosystem Restoration 2021–2030 (the "Decade"), proclaimed by the United Nations General Assembly in resolution 73/284.

Established in 2021, the Decade aims to prevent, halt and reverse the degradation of ecosystems and raise awareness of the importance of restoration, which contributes to achieving the SDGs of the 2030 Agenda. Climate change is having an alarming impact in the region where temperatures have been known to rise to extreme levels. The year 2033 is the ultimate opportunity to prevent catastrophic climate change, and it will also be the year that demarcates the end dates of both the SDGs and the Decade.

Led by the United Nations Environment Programme (UNEP) and FAO, the Decade is building a strong, broad-based global movement to ramp up restoration and put the world on track for a sustainable future.

The Decade emphasizes the need to mainstream landscape restoration knowledge in education and natural resource management programmes at all levels, by instructing and empowering current and future generations of professionals, educators, policymakers, private-sector leaders, implementers, practitioners, researchers, community leaders, youth and volunteers. It also highlights the importance of learning and sharing the knowledge developed by Indigenous Peoples and local communities, and recognizing their contributions to current restoration efforts around the world.

Effective restoration of degraded ecosystems is of paramount importance for recovering biodiversity, ecosystem health and integrity, protecting ecosystem goods and services, mitigating climate change and promoting human health and well-being.

One of the core tenets of the Decade is that successful ecosystem restoration requires a wider socioeconomic transition towards a nature-positive economy where economic growth is decoupled from unsustainable use of natural resources, and economic activity does not damage biodiversity, ecosystems or the climate.

The Decade offers a chance to raise awareness on these major challenges and opportunities, emphasizing the positive impact that a collaborative initiative can have on the sustainable development of the Mediterranean region.

What are World Restoration Flagships

The World Restoration Flagships of the Decade are the first, best or most promising examples of large-scale and long-term ecosystem restoration in any country or region, and embody the ten restoration principles of the Decade.

World Restoration Flagships make ecosystem restoration tangible for a broad audience and inspire a global movement to scale up restoration efforts.

Flagships represent important, inspiring restoration areas with a wider potential for learning and scalability for which the Decade facilitates coordination, learning and scaling, thereby increasing awareness of the area and its challenges. They provide a strategic and innovative approach to restoration and trigger transformational change.

The geographically focused restoration areas selected as flagships will feature prominently on the Decade's digital hub, complemented by information, knowledge, advocacy and communication tools. This facilitates dialogue among stakeholders on results, lessons learned and collaboration.

Hearing it from the experts: inspiring talk with Ann-Kathrin Neureuther

Ann-Kathrin Neureuther is the communication manager for the Decade at UNEP. Based at its headquarters in Nairobi, she leads communication and advocacy for the Decade, working at the intersection of the environmental field and communications.

Prior to joining UNEP, Neureuther led environmental behaviour change campaigns in eight countries for the international non-governmental organization Rare. She coordinated the Global Landscapes Forum for the Center for International Forestry Research (CIFOR) from its inception in Warsaw in 2013 until the 2016 edition in Marrakesh.

Over the past 12 years, Neureuther has worked in Germany, Egypt, Kenya and Indonesia for the United Nations and research institutes. Through her various experiences, she has developed a deep appreciation for pop culture as a connector of people.

6. **What could the successful nomination of the Mediterranean region as a World Restoration Flagship bring to it in terms of visibility with a wider global audience? What channels are being used to promote the flagship?**

The United Nations World Restoration Flagships are our North stars in this big mission of reviving Earth. They are selected as the most ambitious, successful and inspiring examples of making peace with nature, and we, as the Decade Campaign Team, want to make them shine even brighter. We are developing a suite of communication products, such as films, press campaigns, social media outreach, events, celebrity engagements and more. The last group of World Restoration Flagships reached billions of people and is still inspiring stories. In fact, journalists of major media and documentary producers are still getting in touch with us to cover the flagships. We are aiming for the same success in the Mediterranean initiative!

7. **What do you think is the potential of the Mediterranean restoration flagship to inspire others as they work to meet restoration commitments? What are the lessons and best practices that this region can teach the global restoration community?**

The Mediterranean region already feels the climate crisis. Scientists predict that forest fires will increase by 50 percent by the end of this century. Many may not know this, but it is the world's second-largest biodiversity hotspot – after the Andean Mountain Range, which is another World Restoration Flagship. Faced with these immense challenges, the Mediterranean region is undergoing an impressive shift – from dealing with the aftermath of fires and climate impacts to a preventive strategy. By focusing on growing trees, not planting them, and choosing the right trees for the right place, Mediterranean leaders are not only bringing back forests and animals, but building income and a lifeline for communities. This is an impressive feat, and we hope many regions can learn from it!

8. **In which ways can solid communication strategies increase visibility for the flagships and powerful communication boost funding opportunities?**

Throughout human history, the most powerful tool for learning has been stories. Just think about the tales and myths people have been passing on since human communication evolved. The World Restoration Flagships are fairy tales come true. They are grounded in science and measurable achievements, and with our communication, we are looking behind the numbers and highlighting the human work that has been driving their success. This kind of storytelling has already led to the commitment of over 15 million in public funds to all flagships, and after each launch, new private-sector partners are reaching out, wanting to support the work. There is direct kickstart funding of at least USD 200 000 involved for each flagship, but this is really just meant to set the conditions for massive scaling.

9. **In your opinion, how effective can communication be in addressing challenges related to funding?**

Communication is an important pillar – together with solid science and best practices. As explained above, to lead and inspire, we need powerful stories as well as numbers.

10. **In your opinion, what are the essential elements that need to be considered in effective communication on global restoration?**

The amazing thing about restoration is that it is forward-looking. We cannot turn back the time, but we can grow trees, clean up rivers and green our cities. We can be the generation that can make peace with nature. Effective restoration communication needs to first show people the problem and communicate to them why they should care about it. Second, it needs to present a working solution and make people want to contribute to it. And finally, it needs to guide people as to the role that they can play and show them how they can follow the right practices.

The Mediterranean Forest Weeks: a common regional platform for forest matters

Organized every two years, the MFWs bring together a wide range of actors to participate in one of the most vital fora on Mediterranean forests. The biennial event facilitates cooperation among the research community, policymakers and other relevant stakeholders by providing a common regional platform for dialogue on matters related to Mediterranean forests, their importance at global level and their challenges.

The FCNMedNE was the entity in charge of preparing communication for past MFWs, highlighting important research findings, connecting audiences and most importantly, disseminating results and messages beyond the physical borders of the forum.

The network operates through volunteers who are passionate about forests and forestry. They invest effort, time and resources to enable positive impact on Mediterranean forests and communities. Frequent trainings are designed to improve the communication experience and know-how of members for greater impact.

The members from diverse backgrounds are spread across the region and operate in groups. They represent a long chain of messengers disseminating reliable and relevant information from and into the region. Their presence at the MFWs helps raise awareness among many countries of important challenges and potential solutions.

The communication around the MFWs has been successfully generating interest and engaging the general public in important aspects of Mediterranean forests beyond the region's borders.

Tune to the Forest supports the sharing of ideas among young and senior forest experts: a story of successful collaboration between the MYTF and the FCNMedNE

The "Tune to the Forest" virtual café sessions showcase the successful collaboration between the FCNMedNE and the MYTF. By joining efforts and resources, they have created a dynamic exchange platform that facilitates knowledge sharing among foresters, promoting both vertical and horizontal communication. The Tune to the Forest virtual cafés offer a space for young and experienced foresters from the Mediterranean forest community to exchange information and knowledge more effectively. A diverse audience of experts and young professionals gather together to discuss a topic of interest. The initiative enables young foresters to challenge what they know with the help of senior colleagues, allowing them to grow in confidence and revisit their research, and build up their interests and knowledge.

Ways to improve communication and best practices

Scientific researchers are recognized for being credible and knowledgeable professionals, but communication is not always their forte. This can make it difficult for them to capture the attention of the public and policymakers, and get funding for their work despite its value and relevance for society.

Scientific information is often complex and difficult to understand. Scientists can collaborate with communication experts who have the skills to improve the dissemination of research findings.

Communicating scientific information successfully relies on addressing three fundamental questions, as stated in the Strengthening Communication and Education session at the XV World Forestry Congress.

Communication materials induce change by highlighting concrete messages that generate a positive or negative reaction among people.

Community experts have indicated the need to bring scientific research in line with the understanding of the general public. To get their voices and messages heard, scientists are invited to engage with people using everyday language. They could use anecdotes and humour to entertain and better engage audiences on big issues such as restoration, climate change, deforestation and pollution.

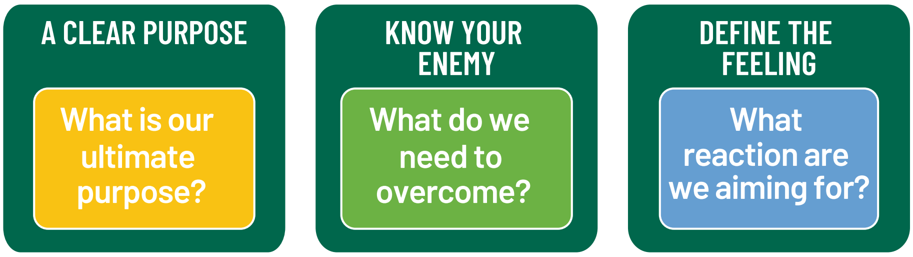
Corinna Keefe, a freelance writer, describes the paramount importance of storytelling when backed up with data in her article titled "Nine powerful stories about climate change": " ... climate change stories (with data to back them up) can influence people towards climate action. Engaging feature stories with an emotional appeal and human interest can have real impact" (Keefe, undated).

When done in a considered way, communicating via social media platforms can spread messages rapidly, with content going viral and the potential to inspire positive change.

Effective communication requires clarity, empathy and a genuine desire to engage and inspire others. Here are some tips for impactful communication:

- **Have a clear purpose**. Scientists and researchers should identify the specific outcomes that they wish to achieve through their communication efforts. Useful,

Figure 2. The three essential elements of successful communication


A CLEAR PURPOSE
What is our ultimate purpose?
KNOW YOUR ENEMY
What do we need to overcome?
DEFINE THE FEELING
What reaction are we aiming for?

Source: Authors' own elaboration

inspiring and relevant messages should be tailored to the specific needs, interests and knowledge level of the audience. It is essential for anyone involved in communication to define the results that they expect to get.

- **Break down complex ideas into simpler terms**. The media often portray forests negatively, focusing on complicated matters and challenges like deforestation, illegal logging and forest fires. They also relay aggressive social media campaigns against cutting trees. However, explaining these issues in simpler terms and conveying positive and appropriate messages using storytelling can inspire the audience to make positive changes.
- **Emotional connection**. Stories have the power to evoke emotions and connect with the audience. Addressing important issues in a lighter way by sharing personal and moving stories creates a connection with the audience and elicits an emotional response about the topic at hand.
- **Active listening**. Active listening is crucial for the communication of science as it allows foresters, researchers, scientists and communicators to better connect with their audience, understand their needs and address their concerns effectively.
- **Use humour**. When communicating about their work, scientists can help the audience retain information longer (Carlson, 2011) by presenting credible information in a relatable and pleasant way.
- **Engage inspiring public figures in raising public awareness**. Inviting prominent public figures to interact and engage with an audience on a topic can help advocate for science, sustainability and positive change. Their involvement and collaboration can help mobilize more people and create momentum to amplify the message effectively.

Communication is a must-have ingredient for success

Communication and finance are fundamental ingredients for the success of many endeavours.

Access to finance is vital for investing in research, innovation, technology and empowerment activities. It is crucial for ensuring the long-term impact of activities, programmes and initiatives.

Communication, on the other hand, can generate interest about key topics and foster collaboration and effective coordination among all stakeholders involved in the development of projects. It can also play a fundamental role in unlocking new funding opportunities by shedding light on the many benefits that investing in FLR actions can yield.

Annually, more than USD 36 billion are needed to meet the Bonn Challenge and USD 318 billion to reach Land Degradation Neutrality (FAO, 2015). In one estimate, restoring 350 million hectares of degraded and deforested land around the world could create up to USD 9 trillion in net benefits (Verdone and Seidl, 2017).

Forest-based initiatives foster local economic growth by generating revenue and supporting the livelihoods of local communities. Forest and landscape restoration activities support the sustainability and profitability of the revitalized landscape, creating job opportunities and improving livelihoods for stakeholders.

This is particularly relevant for the Mediterranean region. With well targeted communication strategies on the enormous potential of restoration, the region could attract more funding and create more jobs.

While effective communication facilitates collaboration, stakeholder engagement and environmental awareness, finance supports investment, conservation efforts, sustainable management and economic viability. The combination of effective communication and financial investment contributes to the overall success of restoration.

Crowdfunding platforms and campaigns can be successful financing initiatives based on effective communication to residents and responsible businesses alike, who take part in sustainable forest management in the Mediterranean region. The initiative Mirlo Positive Nature in Spain exemplifies the mobilization of funds and engagement of citizens in restoration efforts in the Mediterranean.

Moving forward: leveraging communication to restore Mediterranean forests

This article has explored the power of innovative communication strategies that bridge the gap between complex scientific concepts and the general public.

Moving forward, effective science communication needs to be a cornerstone of our work for the conservation and sustainable management of Mediterranean forests. Given the multiple challenges faced by these invaluable ecosystems, we must ensure that scientific information reaches and resonates with all stakeholders, from local communities to policymakers.

As we work together for the well-being of Mediterranean forests, effective science communication can be a catalyst for positive change. By adopting innovative approaches and strategies, and focusing on community and human elements, we can ensure that science makes sense and reaches diverse audiences.

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